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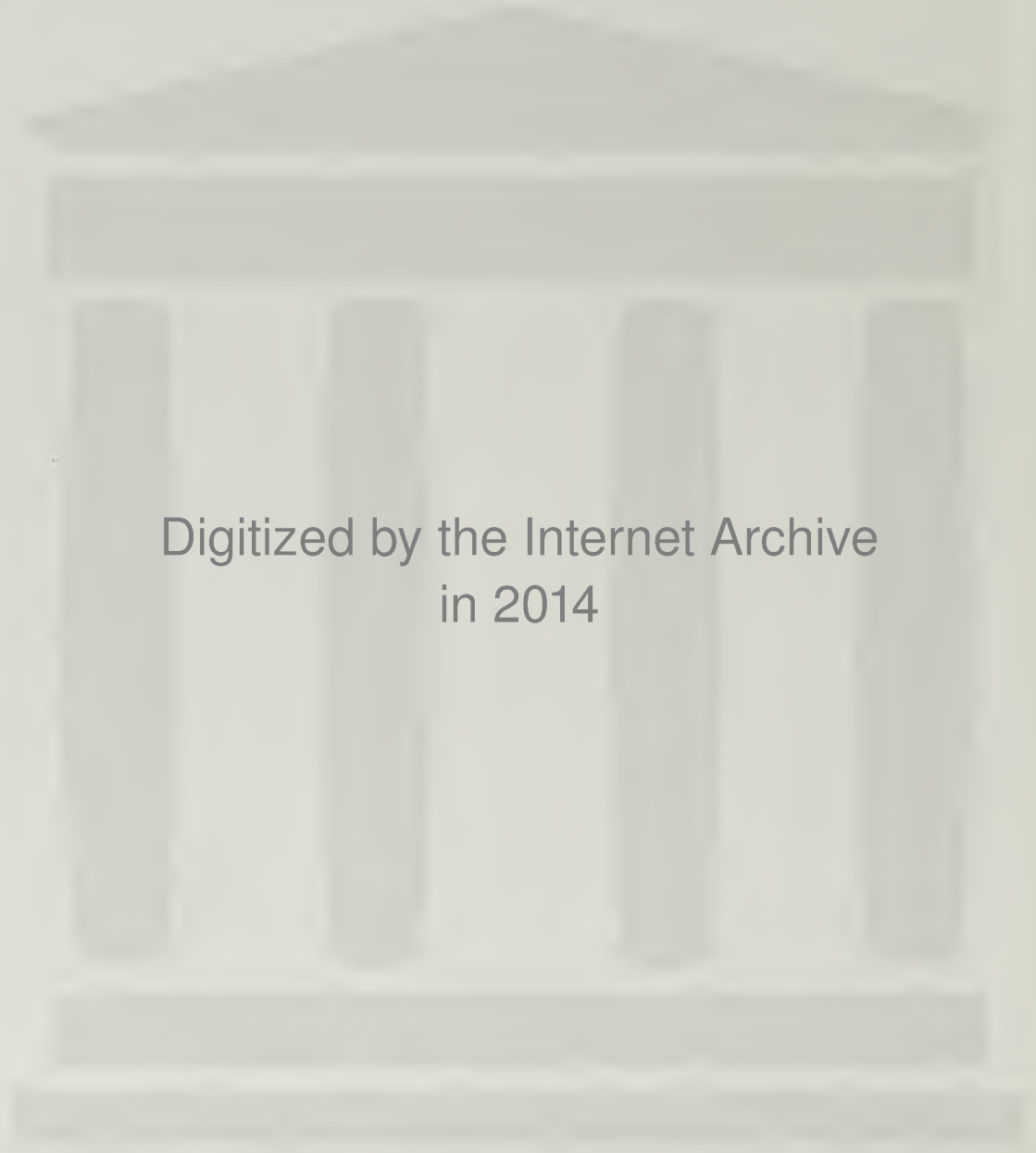
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Final Report:

Massachusetts' Participation in the U.S. Department of Energy's Crystalline Repository Project

December 1986

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DE-FG02-83NE44352

Table of Contents

Section	Page
Introduction	1
Background	1
First Geologic Repository Schedule	2
Second Geologic Repository Schedule	3
CRP Site Screening Methodology	6
Area Phase	9
Specific Project Activities	11
Crystalline Repository Project	12
Impact Upon the Crystalline Rock States	13
Future Concerns for Massachusetts	16
Status of the High-Level Waste Program	17
Appendix A Nuclear Waste Policy Act of 1982	20
Appendix B Letters to DOE	
Appendix C Population Map	
Appendix D Crystalline Rock Body Map	
Appendix E Surface Water Body Map	
Appendix F Seismicity Data	
Appendix G Petrography of Twenty-Five Thin Sections from Diamond Drill Core from the Goshen Gneiss Dome - Western Massachusetts	

Introduction

Over the last three years, the Massachusetts Department of Public Health, Radiation Control Program and the Department of Environmental Quality Engineering have participated in activities related to the screening of potentially acceptable sites for a high-level waste (HLW) repository in crystalline rock. This has been a joint effort involving the U.S. Department of Energy (DOE) and seventeen crystalline rock states, of which Massachusetts is one. The Crystalline Rock Project (CRP) is now in the process of being drastically scaled down and redirected. As a result Massachusetts' participation in the CRP will be concluded as of December 31, 1986.

The purpose of this report is to review activities of the CRP in Massachusetts, the context in which it arose, and the implications and possibilities of future federal policy decisions on the siting of a HLW repository in a crystalline rock body. Although Massachusetts has been eliminated from consideration, there are still issues of concern to be resolved regarding the potential impacts upon Massachusetts if a site were ever to be chosen in New England.

Background

The disposal of spent nuclear fuel and high-level radioactive waste in the U.S. has been a matter of concern for some time. Since 1957, electric utilities have accumulated 10,000 metric tons of HLW. DOE estimates that the total spent fuel inventory will reach approximately 50,000 metric tons by the year 2000.

In response to the inescapable need for a national policy, and the development of a technically and socially acceptable solution, Congress passed the Nuclear Waste Policy Act (NWPA) in 1982. NWPA

established a policy for storing, transporting, and disposing of high-level waste and spent fuel. This law requires DOE to site, construct, and operate the waste repositories. NWPA also requires DOE to submit a proposal to Congress to develop a monitored retrievable storage (MRS) facility; and to develop a program of research, development and demonstration for the disposal of spent nuclear fuel and high-level waste.

The law provides a set of rules for the process of identifying and selecting sites for a repository. NWPA requires selection of a site for a first repository, with initial operation scheduled to begin in 1998. NWPA does not authorize construction of a second repository but it does require DOE to carry out the siting and development activities for a second repository. The following is a summary of the two program phases developed by DOE:

First Geologic Repository Schedule

Issuance of Siting Guidelines	1984
Issuance of Environmental Assessments	1986
Nomination and Recommendation of Sites for Characterization, Presidential approval	1986
Site Characterization Plans and Testing	1986 - 1990
Site Selection	1991
Submission and Review of License Application	1991 - 1994
Site Construction	1994 - 1998
Site Operation	1998

Second Geologic Repository Schedule

Issue Region-To-Area Screening Methodology	April 1985
Issue Final Regional Characterization Reports	September 1985
Issue Final Area Recommendation Report	July 1986
Identify Potentially Acceptable Sites	July 1986
Issue Final Area Characterization Plan	December 1986
Begin Area Phase Field Investigations	December 1986
Complete Area Phase Field Investigations	January 1990
Issue Final Environment Assessments	September 1991
Nominate and Recommend Sites for Characterization	October 1991
President Approves Sites	December 1991
Issue Initial Site Characterization Plan	January 1993
Request Congressional Approval for Construction	March 1993
President Recommends Second Repository Site to Congress	March 1998
Submit License Application to the Nuclear Regulatory Commission	May 1998
Receive Construction Authorization from NRC and Begin Construction	August 2000
Begin Waste Emplacement	June 2006

The first round exclusively assessed the basalt, salt, and tuff formations in the Gulf Coast and Western States. Phase I started with 9 sites in 6 states. A selection process developed and implemented by DOE has culminated in the selection of three specific candidate sites in 1986. These sites are:

- o Yucca Mountain in Nevada
- o Deaf Smith in Texas
- o Hanford in Washington.

These three sites will now be subjected to field testing to determine the most acceptable site for the first geologic repository. The ultimate goal is to have site construction completed and operations begun by 1998.

DOE has been considering three categories of sites for a second repository:

- o Crystalline rock formations[1] in North Central, Northeastern and Southeastern regions of the U.S.;

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1. Crystalline rocks are widespread and underlie large regions of the United States. They are intrusive igneous and high-grade metamorphic rocks rich in silicate minerals with grain size sufficiently course that individual minerals can be easily distinguished. They include granite and similar rocks. It is thought that crystalline rocks have good potential for waste isolation principally because of their mechanical strength, low porosity and permeability, and very low moisture content.

- o Sites previously characterized for the first repository but not selected, and sites evaluated but not nominated for site characterization for the first repository;
- o Sites in other rock types or regions nor yet under consideration.

A principal feature of NWPA is the significant role established for state and tribal governments in the repository siting process. It was under this requirement of the law, that Massachusetts, as a crystalline rock state, sought and received funds from DOE to enable the state to participate in the series of policy and methodolgy decisions required of DOE by NWPA.

The second phase of NWPA involved 17 States having crystalline rock formations. The states are in three regions:

North Central Region	Southeastern Region	Northeastern Region
Michigan	Georgia	Connecticut
Minnesota	Maryland	Maine
Wisconsin	North Carolina	Massachusetts
	South Carolina	New Hampshire
	Virginia	New Jersey
		New York
		Pennsylvania
		Rhode Island
		Vermont

Site screening activities for a second repository evaluated over 200 crystalline rock bodies in the three regions. The screening methodology used was a multi-step process and is described in the next section.

CRP Site Screening Methodology

In September 1984, DOE issued a draft document entitled, "Region-To-Area Screening Methodology for the Crystalline Rock Project." This was the product of discussions and workshops with the 17 states in which rock bodies were surveyed. Massachusetts CRP staff were active participants in this process. The final report, issued in April 1985, describes the process developed by DOE and the states, for narrowing the geologic focus from large regions to smaller areas in studies to identify potential crystalline sites.

The region-to-area screening methodology applied to the 235 crystalline rock bodies consisted of a three-step process.

The first step was to permanently eliminate certain land units from further consideration based on the presence of certain conditions. The following is a list of these disqualifying factors:

- o Federally protected lands
  - National parks
  - National wildlife refuges
  - National wilderness areas
  - National wild and scenic rivers
- o Research Natural areas of National Forests

- o State-protected lands
  - lands comparable to federally protected lands
  - lands dedicated to resource preservation, established prior to NWPA
- o Population distribution and density - areas of 1000 or more persons per square mile
- o Hydrologically significant natural resources, resources greater than 100 meters in depth
- o Deep mines and quarries

The second step in the screening process applied potentially adverse and favorable conditions, present at each site, as scaled regional screening variables to identify the most suitable rock bodies for further analysis in subsequent screen phases. This second step used the geologic and environmental variables based on existing data readily available for the regions under consideration. The following is a list of the 16 variables:

Geologic

- o Rock mass extent
- o Major groundwater discharge zones
- o Rock and mineral resources
- o Seismicity
- o Suspected quaternary faulting
- o Postemplacement faulting

Environmental

- o Proposed federally protected lands
- o Population density
- o Proximity to federally protected lands

- o Proximity to state protected lands
- o National forest lands
- o State forest lands
- o Designated critical habitat for threatened and endangered species
- o Wetlands
- o Surface water bodies
- o Proximity to highly populated areas.

In the screening process, it was important to establish the relative importance of each of these variables in the comparison of sites. To do this, weights were assigned to each variable. The weights were generated at weighting workshops, one for federal Project staff, and one for the states. Nine sets of weights were developed and used to identify 20 areas as most suitable for a repository based on the application of computer-generated summary composite maps.

In the third step of the screening process, DOE conducted sensitivity analyses to verify the quality of the sites selected. This involved consideration of the following:

- o Four additional geologic variables
  - thickness of rock mass extent
  - thickness of overburden
  - state of stress
  - groundwater resources;
- o Modification to the scales of three step 2 variables
  - rock mass extent
  - seismicity
  - proximity to highly populated areas

- o Consideration of various weighting sets
- o Consideration of another method of averaging to determine favorability.

Finally a review of the results of Steps 1 through 3 considering additional qualitative/descriptive information not directly incorporated in those steps was considered. This resulted in the identification of twelve proposed potentially acceptable sites out of the previously selected 20 candidate sites. The remaining eight candidate sites would be considered in subsequent phases if other areas were necessary to meet program requirements.

Area Phase

The 12 potentially acceptable sites were presented in DOE's "draft Area Recommendation Report for the Crystalline Repository Project" released in January 1986. The 12 sites sites identified in the report are:

State	Counties
Georgia	Lamar, Monroe & Upson
Maine	Hancock, Penobscot, & Washington
Maine	Androscoggin, Cumberland, & Oxford
Minnesota	Marshall, Pennington, Polk, & Red Lake
Minnesota	Norman & Polk
Minnesota	Benton, Mille Lacs, Morrison & Sherburne
New Hampshire	Cheshire, Hillsborough, Merrimack, & Sullivan
North Carolina	Franklin, Johnson, & Wake
North Carolina	Buncombe, Haywood, & Madison
Virginia	Bedford
Virginia	Halifax, & Pittsylvania

Wisconsin	Langlade, Menominee, Marathon, Oconto, Portage, Shawano, Waupaca

While Massachusetts was not among those sites chosen, it can be seen that there were three potential sites located in New England. At this point in the project public hearings were held in 15 of the 17 crystalline rock states to explain the program and process and to ellicit comments from the public. Several hearings were held in New England, two in Boston. As might be expected, a great deal of controversy and media attention accompanied these hearings as citizens expressed their views.

Shortly after the hearings were concluded and as the "Area Phase" of the Crystalline Rock Project was about to begin, the major aspects of the second repository program were postponed. This action was taken as a response to reduced growth estimates of spent nuclear fuel and the progress of the first repository program. There is also the expectation that Congress will authorize DOE to proceed with development of a monitored retrievable storage facility. The site-specific activities of the CRP have been indefinitely postponed, but DOE will continue to study non-site-specific technical issues for a second repository.

Had the CRP continued into the area phase, efforts would have focused on the acquisition of new geologic, environmental and socioeconomic data in the 12 proposed potentially acceptable areas. This would include 3 to 4 years of field studies. Evaluation of this data would have led to the identification of potential repository sites and to a

comparison among those sites. This in turn would lead to the nomination and recommendation of candidate sites in 1991. Presidential approval of any crystalline rock sites as a potential second repository would result in more detailed characterization work at the approved site or sites for 4 to 6 years.

DOE's postponement of some second repository studies will not directly impact Massachusetts as there were no potentially acceptable sites located within the Commonwealth. However, indirect impacts will result due to cancellation of studies which would have been of interest to Massachusetts. For example, the environmental and health and safety impacts of transporting the waste on state roads and railways has been a concern voiced by project staff and Massachusetts citizens. Similarly another area of interest would have been the socioeconomic effects resulting from a site situated in New England.

Specific Project Activities

The primary avenue for state participation in the DOE second repository program was to review and comment on federal reports. In general the project activities which were undertaken include:

- o Review and comment on:
  - Draft, and Final Civilian Radioactive Waste Management Program Mission Plan
  - Draft, and Final Region-To-Area Screening Methodology Reports
  - Draft, and Final Regional Characterization Reports
  - Draft Area Recommendation Report

Crystalline Repository Project

On May 28, 1986, the U.S. Department of Energy announced that sites in Nevada, Texas and Washington had been selected for site characterization as candidates for the Nation's first geologic repository for the permanent disposal of spent nuclear fuel and high-level radioactive waste.

At the same time, DOE announced that it was postponing indefinitely site-specific work for a second repository, but it would continue studies on technical issues. DOE listed a number of factors as the basis for reaching this decision:

- o The continuing progress in siting the first repository;
- o The expectation of receiving Congressional authorization to proceed with the development of a monitored retrievable storage facility;
- o Projections of spent fuel generation have been declining;
- o NWPA puts a limit of 70,000 metric tons of spent fuel that can be placed in the first repository before a second repository is in operation. DOE projects that amount to be very far in the future and feels that Congress doesn't need to reconsider a second repository until at least the mid-1990's or much later;
- o A decision on spending hundreds of millions of dollars now on siting a second repository would be premature and unsound fiscal management.

The grand political compromise supporting NWPA was regional equity with two sites - one in the west and one in the east. DOE's decision to postpone the second round repository site selection took both the

first and second round states completely by surprise. Many people feel the decision may have been prompted by the more than 60,000 comments received on the draft Area Recommendation Report which was released in January. Many citizens complained that "...election year politics rather than technical considerations were responsible for the decision..."

Eliminating the second round repository siting process leaves the burden of disposing of the nation's high-level radioactive wastes on the first round western states. This burden hardly seem fair considering that 90% of the nation's radioactive waste is generated in the East.

Charges have been made before Congressional Subcommittees that the second round siting process was technically and procedurally flawed. Similar charges have been made concerning the first round process. In October 1986, Congressman Edward Markey's (D-MA.) Subcommittee on Energy, Conservation and Power of the House Committee on Energy and Commerce released a report charging that DOE [appears to have manipulated data, weighting factors and analytic techniques to arrive at a predetermined set of sites...for the first repository]. This refers to the selection of Hanford, Washington as one of the top three candidate sites for a repository when it actually ranked fifth on a scale based on a multi-attribute utility analysis (MUA) used by DOE.

Impact Upon The Crystalline Rock States

With the postponement of the second round siting process, funding for the crystalline rock states' participation in the repository siting effort has been discontinued. As part of its mandate under the NWPA to continue studies for a second repository, DOE is participating in

two multi-national research projects that could influence the crystalline rock repository program in the United States.

The Stripa Mine Project in Sweden is the focus of an international effort by Canada, France, Japan, Sweden, Switzerland, the United Kingdom and the United States to study radioactive waste disposal in crystalline rock. The underground test facilities are located in granite about 1150 feet below the surface and well below the water table. The purpose of the research at Stripa is to study the effects of repository waste upon groundwater flow.

Atomic Energy of Canada LTD is constructing an underground research laboratory in an undisturbed crystalline rock body near Pinawa in southeastern Manitoba, which is 60 miles north of the Minnesota border. The laboratory will consist of several test rooms at a depth of 775 feet. Among the research proposed at this laboratory and related sites in Manitoba and Ontario include borehole testing, groundwater testing and modeling, fracture and shaft sealing, and tests to determine the interaction between surface and subsurface features.

The United States has been conducting joint research at the lab for several years. In 1985, DOE proposed funding a new multi-million dollar research program that would include a deepening of the test shaft at approximately 1400 feet. Data gathered from this joint research could be applied to crystalline rock sites in the United States.

The implications of this research have raised many concerns. If the

search for a repository in crystalline rock should resume, necessary data collection and field investigations at crystalline rock sites in the U.S. could be viewed as duplicative of the work already completed in Canada. DOE could rely on Canadian data as representative of Minnesota's crystalline rock bodies. While potentially acceptable sites in crystalline rock named in the draft Area Recommendation Report are no longer under active consideration for a repository, they have not been precluded from ever being considered in the future if and when DOE reactivates the site specific screening activities.

With funding discontinued for participation in the repository siting process, the crystalline rock states have expressed concern over whether a fair and objective siting process for a repository can be achieved, particularly in light of the cooperative international research being conducted in crystalline rock. Western states have also questioned whether a fair siting process can be achieved if the second round siting process is eliminated.

Postponing the second round site selection could also be a violation of NWPA because eliminating the second repository would require an amendment to the Act to remove the limit of 70,000 metric tons on the first repository. Congress would have to reopen the Act for discussion and amendment. It is uncertain what kind of effect this would have on the crystalline rock states. If the Act is reopened, states will need to prepare to discuss the Act.

With cooperative research efforts in Canada and Sweden, it is conceivable that DOE may want to reopen the second round process and exclude everyone but the crystalline rock states selected in the draft

Area Recommendation Report which was released in January 1986. For these reasons it is important for states to maintain an ongoing effort to monitor DOE's high-level waste activities.

Future Concerns For Massachusetts

It is highly unlikely that Massachusetts will again be considered as a potential host state for a high-level radioactive waste repository. However, there are a some outstanding issues that will have some impact on the Commonwealth, most notably the transportation system.

High-level radioactive waste from nuclear power plants in New England will probably pass through Massachusetts on its way to an MRS in Tennessee or a repository in the West. DOE has been analyzing different transportation modes and routes in order to select the safest possible means for nuclear waste transport. It is anticipated that 70-80% of the HLW transported will be conducted by train. However, there are no specific rail regulations governing the transportation of nuclear waste.

Among the elements of a transportation system that will affect state responsibilities as well as those of federal agencies are mode of transport and potential risk, prenotification, inspection and enforcement activities, emergency response capabilities, liability and transportation safeguards. There are many constraints surrounding the integration of these features into a transportation system under NWPA. Thus, it is important that the development and implementation of such a system be done in close cooperation with different federal, state and local government entities because of the coordinated efforts that will be required.

Many state and local governments have established their own transportation guidelines, specifying prenotification requirements, time-of-day restrictions, routes and special equipment. However, state and local regulations that unnecessarily burden, delay or ban shipments will be preempted under the Hazardous Materials Transportation Act of 1975. This Act gives DOT the authority to establish standards on "any safety aspect" of transport of hazardous (including radioactive) materials "by any mode" in interstate and foreign commerce.

In August 1986, DOE developed a Transportation Institutional Plan (DOE/RW-0094) to "...establish a foundation for interaction among all interested parties in working to address and resolve issues related to the establishment and operation of the NWPA transportation system." The plan commits DOE to maintain "working relationships" and direct contact with all states, Indian tribes, and local governments through which spent fuel will be transported. While DOE is not prepared to fund individual states' efforts, the Office of Civilian Radioactive Waste Management will use cooperative agreements with certain regional organizations to enable states, Indian tribes, and other parties to participate in the identification and resolution of issues associated with the transportation of spent nuclear fuel and high-level radioactive waste from reactors to the repository site.

Status of the High-Level Waste Program

The search for a high-level nuclear waste repository has been controversial. There are numerous technical and legal issues that need to be resolved.

The process is also political. No one wants a repository in their state. Since the November 1986 elections, opposition to DOE's HLW activities has grown in strength in the U.S. Senate as well as the House of Representatives. With political pressure from the first round states, it is expected that western representatives in Congress will make amending the NWPA a priority issue in 1987.

Meanwhile on November 25, 1986, a three judge panel of the U.S. Court of Appeals for the Sixth Circuit ruled against the State of Tennessee's petition to halt submission of a DOE proposal to Congress to construct a Monitored Retrievable Storage Facility (MRS). The MRS would serve as a receiving packaging and handling facility for spent fuel shipments from utilities in the eastern half of the U.S. DOE is expected to move quickly on submitting the MRS proposal to Congress. It is anticipated that the MRS may not meet as much opposition from Congress when they consider alternatives such as opening the Act for debate or reinstating the second round repository program

Another important issue coming before Congress in 1987 is the renewal of the Price-Anderson Act. Price-Anderson establishes the method for paying damages suffered by the public as the result of certain nuclear incidents, including those involving the transportation of nuclear materials to or from facilities covered under the Act. During the past year, Congress has been reviewing Price-Anderson to consider whether it should be extended and, if so, whether the present coverage should be expanded. Among the issues under consideration are the limits on liability; coverage in the event of sabotage or theft of nuclear materials during transportation; and whether state or local

governments are liable for accidents due to poorly maintained roads and bridges in their jurisdictions.

Since the passage of NWPA, States and Indian tribes have participated in reviewing and commenting on HLW program documents. The opportunity to provide input into program issues has enabled the states to gain a better understanding of the complex decision-making process involved in the search for a repository site.

The postponement of the second repository program has lead to cutbacks in DOE's funding of states' participation in the HLW program. As a result, States and Indian tribes will be hard pressed to continue monitoring DOE's efforts to site a repository.

State and public participation in the HLW program is essential if DOE hopes to restore confidence as well as enhance public acceptance of its HLW activities.

APPENDIX A

NUCLEAR WASTE POLICY ACT OF 1982

Public Law 97-425
97th Congress

An Act

To provide for the development of repositories for the disposal of high-level radioactive waste and spent nuclear fuel, to establish a program of research, development, and demonstration regarding the disposal of high-level radioactive waste and spent nuclear fuel, and for other purposes.

Jan. 7, 1983
[H.R. 3809]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Nuclear Waste Policy Act of 1982.
42 USC 10101 note.

SHORT TITLE AND TABLE OF CONTENTS

SECTION 1. This Act may be cited as the "Nuclear Waste Policy Act of 1982".

TABLE OF CONTENTS

Sec. 1. Short title and table of contents.
Sec. 2. Definitions.
Sec. 3. Separability.
Sec. 4. Territories and possessions.
Sec. 5. Ocean disposal.
Sec. 6. Limitation on spending authority.
Sec. 7. Protection of classified national security information.
Sec. 8. Applicability.
Sec. 9. Applicability.

TITLE I—DISPOSAL AND STORAGE OF HIGH-LEVEL RADIOACTIVE WASTE, SPENT NUCLEAR FUEL, AND LOW-LEVEL RADIOACTIVE WASTE

Sec. 101. State and affected Indian tribe participation in development of proposed repositories for defense waste.

SUBTITLE A—REPOSITORIES FOR DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL

Sec. 111. Findings and purposes.
Sec. 112. Recommendation of candidate sites for site characterization.
Sec. 113. Site characterization.
Sec. 114. Site approval and construction authorization.
Sec. 115. Review of repository site selection.
Sec. 116. Participation of States.
Sec. 117. Consultation with States and Indian tribes.
Sec. 118. Participation of Indian tribes.
Sec. 119. Judicial review of agency actions.
Sec. 120. Expedited authorizations.
Sec. 121. Certain standards and criteria.
Sec. 122. Disposal of spent nuclear fuel.
Sec. 123. Title to material.
Sec. 124. Consideration of effect of acquisition of water rights.
Sec. 125. Termination of certain provisions.

SUBTITLE B—INTERIM STORAGE PROGRAM

Sec. 131. Findings and purposes.
Sec. 132. Available capacity for interim storage of spent nuclear fuel.
Sec. 133. Interim at-reactor storage.
Sec. 134. Licensing of facility expansions and transshipments.
Sec. 135. Storage of spent nuclear fuel.
Sec. 136. Interim Storage Fund.
Sec. 137. Transportation.

SUBTITLE C—MONITORED RETRIEVABLE STORAGE

Sec. 141. Monitored retrievable storage.

SUBTITLE D—LOW-LEVEL RADIOACTIVE WASTE

Sec. 151. Financial arrangements for site closure.

TITLE II—RESEARCH, DEVELOPMENT, AND DEMONSTRATION REGARDING DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL

Sec. 211. Purpose.
Sec. 212. Applicability.
Sec. 213. Identification of sites.
Sec. 214. Siting research and related activities.
Sec. 215. Test and evaluation facility siting review and reports.
Sec. 216. Federal agency actions.
Sec. 217. Research and development on disposal of high-level radioactive waste.
Sec. 218. Research and development on spent nuclear fuel.
Sec. 219. Payments to States and affected Indian tribes.
Sec. 220. Study of research and development needs for monitored retrievable storage proposal.
Sec. 221. Judicial review.
Sec. 222. Research on alternatives for the permanent disposal of high-level radioactive waste.
Sec. 223. Technical assistance to non-nuclear weapon states in the field of spent fuel storage and disposal.

TITLE III—OTHER PROVISIONS RELATING TO RADIOACTIVE WASTE

Sec. 301. Mission plan.
Sec. 302. Nuclear Waste Fund.
Sec. 303. Alternate means of financing.
Sec. 304. Office of Civilian Radioactive Waste Management.
Sec. 305. Location of test and evaluation facility.
Sec. 306. Nuclear Regulatory Commission training authorization.

DEFINITIONS

42 USC 10101.

SEC. 2. For purposes of this Act:

(1) The term "Administrator" means the Administrator of the Environmental Protection Agency.

(2) The term "affected Indian tribe" means any Indian tribe—

(A) within whose reservation boundaries a monitored retrievable storage facility, test and evaluation facility, or a repository for high-level radioactive waste or spent fuel is proposed to be located;

(B) whose federally defined possessory or usage rights to other lands outside of the reservation's boundaries arising out of congressionally ratified treaties may be substantially and adversely affected by the locating of such a facility: *Provided*, That the Secretary of the Interior finds, upon the petition of the appropriate governmental officials of the tribe, that such effects are both substantial and adverse to the tribe;

(3) The term "atomic energy defense activity" means any activity of the Secretary performed in whole or in part in carrying out any of the following functions:

(A) naval reactors development;

(B) weapons activities including defense inertial confinement fusion;

(C) verification and control technology;

(D) defense nuclear materials production;

(E) defense nuclear waste and materials by-products management;

(F) defense nuclear materials security and safeguards and security investigations; and

(G) defense research and development.

(4) The term "candidate site" means an area, within a geologic and hydrologic system, that is recommended by the Secretary under section 112 for site characterization, approved by the President under section 112 for site characterization, or undergoing site characterization under section 113.

(5) The term "civilian nuclear activity" means any atomic energy activity other than an atomic energy defense activity.

(6) The term "civilian nuclear power reactor" means a civilian nuclear powerplant required to be licensed under section 103 or 104 b. of the Atomic Energy Act of 1954 (42 U.S.C. 2133, 2134(b)).

(7) The term "Commission" means the Nuclear Regulatory Commission.

(8) The term "Department" means the Department of Energy.

(9) The term "disposal" means the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste.

(10) The terms "disposal package" and "package" mean the primary container that holds, and is in contact with, solidified high-level radioactive waste, spent nuclear fuel, or other radioactive materials, and any overpacks that are emplaced at a repository.

(11) The term "engineered barriers" means manmade components of a disposal system designed to prevent the release of radionuclides into the geologic medium involved. Such term includes the high-level radioactive waste form, high-level radioactive waste canisters, and other materials placed over and around such canisters.

(12) The term "high-level radioactive waste" means—

(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

(B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.

(13) The term "Federal agency" means any Executive agency, as defined in section 105 of title 5, United States Code.

(14) The term "Governor" means the chief executive officer of a State.

(15) The term "Indian tribe" means any Indian tribe, band, nation, or other organized group or community of Indians recognized as eligible for the services provided to Indians by the Secretary of the Interior because of their status as Indians, including any Alaska Native village, as defined in section 3(c) of the Alaska Native Claims Settlement Act (43 U.S.C. 1602(c)).

(16) The term "low-level radioactive waste" means radioactive material that—

(A) is not high-level radioactive waste, spent nuclear fuel, transuranic waste, or by-product material as defined in

section 11e(2) of the Atomic Energy Act of 1954 (42 U.S.C. 2014(e)(2)); and

(B) the Commission, consistent with existing law, classifies as low-level radioactive waste.

(17) The term "Office" means the Office of Civilian Radioactive Waste Management established in section 305.

Post, p. 2262.

(18) The term "repository" means any system licensed by the Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any materials placed in such system. Such term includes both surface and subsurface areas at which high-level radioactive waste and spent nuclear fuel handling activities are conducted.

(19) The term "reservation" means—

(A) any Indian reservation or dependent Indian community referred to in clause (a) or (b) of section 1151 of title 18, United States Code; or

(B) any land selected by an Alaska Native village or regional corporation under the provisions of the Alaska Native Claims Settlement Act (43 U.S.C. 1601 et seq.).

(20) The term "Secretary" means the Secretary of Energy.

(21) The term "site characterization" means—

(A) siting research activities with respect to a test and evaluation facility at a candidate site; and

(B) activities, whether in the laboratory or in the field, undertaken to establish the geologic condition and the ranges of the parameters of a candidate site relevant to the location of a repository, including borings, surface excavations, excavations of exploratory shafts, limited subsurface lateral excavations and borings, and in situ testing needed to evaluate the suitability of a candidate site for the location of a repository, but not including preliminary borings and geophysical testing needed to assess whether site characterization should be undertaken.

(22) The term "siting research" means activities, including borings, surface excavations, shaft excavations, subsurface lateral excavations and borings, and in situ testing, to determine the suitability of a site for a test and evaluation facility.

(23) The term "spent nuclear fuel" means fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

(24) The term "State" means each of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and any other territory or possession of the United States.

(25) The term "storage" means retention of high-level radioactive waste, spent nuclear fuel, or transuranic waste with the intent to recover such waste or fuel for subsequent use, processing, or disposal.

(26) The term "Storage Fund" means the Interim Storage Fund established in section 137(c).

(27) The term "test and evaluation facility" means an at-depth, prototypic, underground cavity with subsurface lateral

excavations extending from a central shaft that is used for research and development purposes, including the development of data and experience for the safe handling and disposal of solidified high-level radioactive waste, transuranic waste, or spent nuclear fuel.

(28) The term "unit of general local government" means any borough, city, county, parish, town, township, village, or other general purpose political subdivision of a State.

(29) The term "Waste Fund" means the Nuclear Waste Fund established in section 302(c). *Post*, p. 2257.

SEPARABILITY

SEC. 3. If any provision of this Act, or the application of such provision to any person or circumstance, is held invalid, the remainder of this Act, or the application of such provision to persons or circumstances other than those as to which it is held invalid, shall not be affected thereby. 42 USC 10102.

TERRITORIES AND POSSESSIONS

SEC. 4. Nothing in this Act shall be deemed to repeal, modify, or amend the provisions of section 605 of the Act of March 12, 1980 (48 U.S.C. 1491). 42 USC 10103.

OCEAN DISPOSAL

SEC. 5. Nothing in this Act shall be deemed to affect the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1401 et seq.). 42 USC 10104.

LIMITATION ON SPENDING AUTHORITY

SEC. 6. The authority under this Act to incur indebtedness, or enter into contracts, obligating amounts to be expended by the Federal Government shall be effective for any fiscal year only to such extent or in such amounts as are provided in advance by appropriation Acts. 42 USC 10105.

PROTECTION OF CLASSIFIED NATIONAL SECURITY INFORMATION

SEC. 7. Nothing in this Act shall require the release or disclosure to any person or to the Commission of any classified national security information. 42 USC 10106.

APPLICABILITY

SEC. 8. (a) ATOMIC ENERGY DEFENSE ACTIVITIES.—Subject to the provisions of subsection (c), the provisions of this Act shall not apply with respect to any atomic energy defense activity or to any facility used in connection with any such activity. 42 USC 10107

(b) EVALUATION BY PRESIDENT.—(1) Not later than 2 years after the date of the enactment of this Act, the President shall evaluate the use of disposal capacity at one or more repositories to be developed under subtitle A of title I for the disposal of high-level radioactive waste resulting from atomic energy defense activities. Such evaluation shall take into consideration factors relating to cost *Post*, p. 2207

efficiency, health and safety, regulation, transportation, public acceptability, and national security.

(2) Unless the President finds, after conducting the evaluation required in paragraph (1), that the development of a repository for the disposal of high-level radioactive waste resulting from atomic energy defense activities only is required, taking into account all of the factors described in such subsection, the Secretary shall proceed promptly with arrangement for the use of one or more of the repositories to be developed under subtitle A of title I for the disposal of such waste. Such arrangements shall include the allocation of costs of developing, constructing, and operating this repository or repositories. The costs resulting from permanent disposal of high-level radioactive waste from atomic energy defense activities shall be paid by the Federal Government, into the special account established under section 302.

Post, p. 2207.

Post, p. 2257.

(3) Any repository for the disposal of high-level radioactive waste resulting from atomic energy defense activities only shall (A) be subject to licensing under section 202 of the Energy Reorganization Act of 1973 (42 U.S.C. 5842); and (B) comply with all requirements of the Commission for the siting, development, construction, and operation of a repository.

(c) APPLICABILITY TO CERTAIN REPOSITORIES.—The provisions of this Act shall apply with respect to any repository not used exclusively for the disposal of high-level radioactive waste or spent nuclear fuel resulting from atomic energy defense activities, research and development activities of the Secretary, or both.

APPLICABILITY

42 USC 10108

SEC. 9. TRANSPORTATION.—Nothing in this Act shall be construed to affect Federal, State, or local laws pertaining to the transportation of spent nuclear fuel or high-level radioactive waste.

TITLE I—DISPOSAL AND STORAGE OF HIGH-LEVEL RADIOACTIVE WASTE, SPENT NUCLEAR FUEL, AND LOW-LEVEL RADIOACTIVE WASTE

STATE AND AFFECTED INDIAN TRIBE PARTICIPATION IN DEVELOPMENT OF PROPOSED REPOSITORIES FOR DEFENSE WASTE

42 USC 10121

SEC. 101. (a) NOTIFICATION TO STATES AND AFFECTED INDIAN TRIBES.—Notwithstanding the provisions of section 8, upon any decision by the Secretary or the President to develop a repository for the disposal of high-level radioactive waste or spent nuclear fuel resulting exclusively from atomic energy defense activities, research and development activities of the Secretary, or both, and before proceeding with any site-specific investigations with respect to such repository, the Secretary shall notify the Governor and legislature of the State in which such repository is proposed to be located, or the governing body of the affected Indian tribe on whose reservation such repository is proposed to be located, as the case may be, of such decision.

(b) PARTICIPATION OF STATES AND AFFECTED INDIAN TRIBES.—Following the receipt of any notification under subsection (a), the State or Indian tribe involved shall be entitled, with respect to the proposed repository involved, to rights of participation and consultation identical to those provided in sections 115 through 118, except that

any financial assistance authorized to be provided to such State or affected Indian tribe under section 116(c) or 118(b) shall be made from amounts appropriated to the Secretary for purposes of carrying out this section.

SUBTITLE A—REPOSITORIES FOR DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL

FINDINGS AND PURPOSES

SEC. 111. (a) FINDINGS.—The Congress finds that— 42 USC 10131.

(1) radioactive waste creates potential risks and requires safe and environmentally acceptable methods of disposal;

(2) a national problem has been created by the accumulation of (A) spent nuclear fuel from nuclear reactors; and (B) radioactive waste from (i) reprocessing of spent nuclear fuel; (ii) activities related to medical research, diagnosis, and treatment; and (iii) other sources;

(3) Federal efforts during the past 30 years to devise a permanent solution to the problems of civilian radioactive waste disposal have not been adequate;

(4) while the Federal Government has the responsibility to provide for the permanent disposal of high-level radioactive waste and such spent nuclear fuel as may be disposed of in order to protect the public health and safety and the environment, the costs of such disposal should be the responsibility of the generators and owners of such waste and spent fuel;

(5) the generators and owners of high-level radioactive waste and spent nuclear fuel have the primary responsibility to provide for, and the responsibility to pay the costs of, the interim storage of such waste and spent fuel until such waste and spent fuel is accepted by the Secretary of Energy in accordance with the provisions of this Act;

(6) State and public participation in the planning and development of repositories is essential in order to promote public confidence in the safety of disposal of such waste and spent fuel; and

(7) high-level radioactive waste and spent nuclear fuel have become major subjects of public concern, and appropriate precautions must be taken to ensure that such waste and spent fuel do not adversely affect the public health and safety and the environment for this or future generations.

(b) PURPOSES.—The purposes of this subtitle are—

(1) to establish a schedule for the siting, construction, and operation of repositories that will provide a reasonable assurance that the public and the environment will be adequately protected from the hazards posed by high-level radioactive waste and such spent nuclear fuel as may be disposed of in a repository;

(2) to establish the Federal responsibility, and a definite Federal policy, for the disposal of such waste and spent fuel;

(3) to define the relationship between the Federal Government and the State governments with respect to the disposal of such waste and spent fuel; and

(4) to establish a Nuclear Waste Fund, composed of payments made by the generators and owners of such waste and spent fuel, that will ensure that the costs of carrying out activities

relating to the disposal of such waste and spent fuel will be borne by the persons responsible for generating such waste and spent fuel.

RECOMMENDATION OF CANDIDATE SITES FOR SITE CHARACTERIZATION

42 USC 10132

SEC. 112. (a) GUIDELINES.—Not later than 180 days after the date of the enactment of this Act, the Secretary, following consultation with the Council on Environmental Quality, the Administrator of the Environmental Protection Agency, the Director of the Geological Survey, and interested Governors, and the concurrence of the Commission shall issue general guidelines for the recommendation of sites for repositories. Such guidelines shall specify detailed geologic considerations that shall be primary criteria for the selection of sites in various geologic media. Such guidelines shall specify factors that qualify or disqualify any site from development as a repository, including factors pertaining to the location of valuable natural resources, hydrology, geophysics, seismic activity, and atomic energy defense activities, proximity to water supplies, proximity to populations, the effect upon the rights of users of water, and proximity to components of the National Park System, the National Wildlife Refuge System, the National Wild and Scenic Rivers System, the National Wilderness Preservation System, or National Forest Lands. Such guidelines shall take into consideration the proximity to sites where high-level radioactive waste and spent nuclear fuel is generated or temporarily stored and the transportation and safety factors involved in moving such waste to a repository. Such guidelines shall specify population factors that will disqualify any site from development as a repository if any surface facility of such repository would be located (1) in a highly populated area; or (2) adjacent to an area 1 mile by 1 mile having a population of not less than 1,000 individuals. Such guidelines also shall require the Secretary to consider the cost and impact of transporting to the repository site the solidified high-level radioactive waste and spent fuel to be disposed of in the repository and the advantages of regional distribution in the siting of repositories. Such guidelines shall require the Secretary to consider the various geologic media in which sites for repositories may be located and, to the extent practicable, to recommend sites in different geologic media. The Secretary shall use guidelines established under this subsection in considering candidate sites for recommendation under subsection (b). The Secretary may revise such guidelines from time to time, consistent with the provisions of this subsection.

(b) RECOMMENDATION BY SECRETARY TO THE PRESIDENT.—(1)(A) Following the issuance of guidelines under subsection (a) and consultation with the Governors of affected States, the Secretary shall nominate at least 5 sites that he determines suitable for site characterization for selection of the first repository site.

Recommendation date

(B) Subsequent to such nomination, the Secretary shall recommend to the President 3 of the nominated sites not later than January 1, 1985 for characterization as candidate sites.

(C) Not later than July 1, 1989, the Secretary shall nominate 5 sites, which shall include at least 3 additional sites not nominated under subparagraph (A), and recommend by such date to the President from such 5 nominated sites 3 candidate sites the Secretary determines suitable for site characterization for selection of the second repository. The Secretary may not nominate any site previ-

ously nominated under subparagraph (A), that was not recommended as a candidate site under subparagraph (B).

(D) Such recommendations under subparagraphs (B) and (C) shall be consistent with the provisions of section 305.

Post, p. 2262.

(E) Each nomination of a site under this subsection shall be accompanied by an environmental assessment, which shall include a detailed statement of the basis for such recommendation and of the probable impacts of the site characterization activities planned for such site, and a discussion of alternative activities relating to site characterization that may be undertaken to avoid such impacts. Such environmental assessment shall include—

Environmental assessment.

(i) an evaluation by the Secretary as to whether such site is suitable for site characterization under the guidelines established under subsection (a);

(ii) an evaluation by the Secretary as to whether such site is suitable for development as a repository under each such guideline that does not require site characterization as a prerequisite for application of such guideline;

(iii) an evaluation by the Secretary of the effects of the site characterization activities at such site on the public health and safety and the environment;

(iv) a reasonable comparative evaluation by the Secretary of such site with other sites and locations that have been considered;

(v) a description of the decision process by which such site was recommended; and

(vi) an assessment of the regional and local impacts of locating the proposed repository at such site.

(F)(i) The issuance of any environmental assessment under this paragraph shall be considered to be a final agency action subject to judicial review in accordance with the provisions of chapter 7 of title 5, United States Code, and section 119. Such judicial review shall be limited to the sufficiency of such environmental assessment with respect to the items described in clauses (i) through (vi) of subparagraph (E).

Judicial review.

5 USC 701 *et seq.*

(G) Each environmental assessment prepared under this paragraph shall be made available to the public.

Public availability.

(H) Before nominating a site, the Secretary shall notify the Governor and legislature of the State in which such site is located, or the governing body of the affected Indian tribe where such site is located, as the case may be, of such nomination and the basis for such nomination.

(2) Before nominating any site the Secretary shall hold public hearings in the vicinity of such site to inform the residents of the area in which such site is located of the proposed nomination of such site and to receive their comments. At such hearings, the Secretary shall also solicit and receive any recommendations of such residents with respect to issues that should be addressed in the environmental assessment described in paragraph (1) and the site characterization plan described in section 113(b)(1).

Hearings.

(3) In evaluating the sites nominated under this section prior to any decision to recommend a site as a candidate site, the Secretary shall use available geophysical, geologic, geochemical and hydrologic, and other information and shall not conduct any preliminary borings or excavations at a site unless (i) such preliminary boring or excavation activities were in progress upon the date of enactment of this Act or (ii) the Secretary certifies that such available informa-

tion from other sources, in the absence of preliminary borings or excavations, will not be adequate to satisfy applicable requirements of this Act or any other law: *Provided*, That preliminary borings or excavations under this section shall not exceed a diameter of 6 inches.

(c) PRESIDENTIAL REVIEW OF RECOMMENDED CANDIDATE SITES.—(1) The President shall review each candidate site recommendation made by the Secretary under subsection (b). Not later than 60 days after the submission by the Secretary of a recommendation of a candidate site, the President, in his discretion, may either approve or disapprove such candidate site, and shall transmit any such decision to the Secretary and to either the Governor and legislature of the State in which such candidate site is located, or the governing body of the affected Indian tribe where such candidate site is located, as the case may be. If, during such 60-day period, the President fails to approve or disapprove such candidate site, or fails to invoke his authority under paragraph (2) to delay his decision, such candidate site shall be considered to be approved, and the Secretary shall notify such Governor and legislature, or governing body of the affected Indian tribe, of the approval of such candidate site by reason of the inaction of the President.

Decision transmittal or notification.

(2) The President may delay for not more than 6 months his decision under paragraph (1) to approve or disapprove a candidate site, upon determining that the information provided with the recommendation of the Secretary is insufficient to permit a decision within the 60-day period referred to in paragraph (1). The President may invoke his authority under this paragraph by submitting written notice to the Congress, within such 60-day period, of his intent to invoke such authority. If the President invokes such authority, but fails to approve or disapprove the candidate site involved by the end of such 6-month period, such candidate site shall be considered to be approved, and the Secretary shall notify such Governor and legislature, or governing body of the affected Indian tribe, of the approval of such candidate site by reason of the inaction of the President.

(d) CONTINUATION OF CANDIDATE SITE SCREENING.—After the required recommendation of candidate sites under subsection (b), the Secretary may continue, as he determines necessary, to identify and study other sites to determine their suitability for recommendation for site characterization, in accordance with the procedures described in this section.

(e) PRELIMINARY ACTIVITIES.—Except as otherwise provided in this section, each activity of the President or the Secretary under this section shall be considered to be a preliminary decisionmaking activity. No such activity shall require the preparation of an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)), or to require any environmental review under subparagraph (E) or (F) of section 102(2) of such Act.

(f) TIMELY SITE CHARACTERIZATION.—Nothing in this section may be construed as prohibiting the Secretary from continuing ongoing or presently planned site characterization at any site on Department of Energy land for which the location of the principal borehole has been approved by the Secretary by August 1, 1982, except that (1) the environmental assessment described in subsection (b)(1) shall be prepared and made available to the public before proceeding to sink shafts at any such site; and (2) the Secretary shall not continue site characterization at any such site unless such site is among the

candidate sites recommended by the Secretary under the first sentence of subsection (b) for site characterization and approved by the President under subsection (c); and (3) the Secretary shall conduct public hearings under 113(b)(2) and comply with requirements under section 117 of this Act within one year of the date of enactment.

Hearings.

SITE CHARACTERIZATION

SEC. 113. (a) IN GENERAL.—The Secretary shall carry out, in accordance with the provisions of this section, appropriate site characterization activities beginning with the candidate sites that have been approved under section 112 and are located in various geologic media. The Secretary shall consider fully the comments received under subsection (b)(2) and section 112(b)(2) and shall, to the maximum extent practicable and in consultation with the Governor of the State involved or the governing body of the affected Indian tribe involved, conduct site characterization activities in a manner that minimizes any significant adverse environmental impacts identified in such comments or in the environmental assessment submitted under subsection (b)(1).

42 USC 10133.

(b) COMMISSION AND STATES.—(1) Before proceeding to sink shafts at any candidate site, the Secretary shall submit for such candidate site to the Commission and to either the Governor and legislature of the State in which such candidate site is located, or the governing body of the affected Indian tribe on whose reservation such candidate site is located, as the case may be, for their review and comment—

Plan submittal, review and comment.

(A) a general plan for site characterization activities to be conducted at such candidate site, which plan shall include—

(i) a description of such candidate site;

(ii) a description of such site characterization activities, including the following: the extent of planned excavations, plans for any onsite testing with radioactive or nonradioactive material, plans for any investigation activities that may affect the capability of such candidate site to isolate high-level radioactive waste and spent nuclear fuel, and plans to control any adverse, safety-related impacts from such site characterization activities;

(iii) plans for the decontamination and decommissioning of such candidate site, and for the mitigation of any significant adverse environmental impacts caused by site characterization activities if it is determined unsuitable for application for a construction authorization for a repository;

(iv) criteria to be used to determine the suitability of such candidate site for the location of a repository, developed pursuant to section 112(a); and

(v) any other information required by the Commission;

(B) a description of the possible form or packaging for the high-level radioactive waste and spent nuclear fuel to be emplaced in such repository, a description, to the extent practicable, of the relationship between such waste form or packaging and the geologic medium of such site, and a description of the activities being conducted by the Secretary with respect to such possible waste form or packaging or such relationship; and

(C) a conceptual repository design that takes into account likely site-specific requirements.

Public availability; hearings.

(2) Before proceeding to sink shafts at any candidate site, the Secretary shall (A) make available to the public the site characterization plan described in paragraph (1); and (B) hold public hearings in the vicinity of such candidate site to inform the residents of the area in which such candidate site is located of such plan, and to receive their comments.

Report.

(3) During the conduct of site characterization activities at a candidate site, the Secretary shall report not less than once every 6 months to the Commission and to either the Governor and legislature of the State in which such candidate site is located, or the governing body of the affected Indian tribe where such candidate site is located, as the case may be, on the nature and extent of such activities and the information developed from such activities.

(c) RESTRICTIONS.—(1) The Secretary may conduct at any candidate site only such site characterization activities as the Secretary considers necessary to provide the data required for evaluation of the suitability of such candidate site for an application to be submitted to the Commission for a construction authorization for a repository at such candidate site, and for compliance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).

(2) In conducting site characterization activities—

(A) the Secretary may not use any radioactive material at a candidate site unless the Commission concurs that such use is necessary to provide data for the preparation of the required environmental reports and an application for a construction authorization for a repository at such candidate site; and

(B) if any radioactive material is used at a candidate site—

(i) the Secretary shall use the minimum quantity necessary to determine the suitability of such candidate site for a repository, but in no event more than the curie equivalent of 10 metric tons of spent nuclear fuel; and

(ii) such radioactive material shall be fully retrievable.

Notification of site termination.

(3) If site characterization activities are terminated at a candidate site for any reason, the Secretary shall (A) notify the Congress, the Governors and legislatures of all States in which candidate sites are located, and the governing bodies of all affected Indian tribes where candidate sites are located, of such termination and the reasons for such termination; and (B) remove any high-level radioactive waste, spent nuclear fuel, or other radioactive materials at or in such candidate site as promptly as practicable.

(4) If a site is determined to be unsuitable for application for a construction authorization for a repository, the Secretary shall take reasonable and necessary steps to reclaim the site and to mitigate any significant adverse environmental impacts caused by site characterization activities.

(d) PRELIMINARY ACTIVITIES.—Each activity of the Secretary unde. this section that is in compliance with the provisions of subsection (c) shall be considered a preliminary decisionmaking activity. No such activity shall require the preparation of an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)), or to require any environmental review under subparagraph (E) or (F) of section 102(2) of such Act.

SITE APPROVAL AND CONSTRUCTION AUTHORIZATION

SEC. 114. (a) HEARINGS AND PRESIDENTIAL RECOMMENDATION.—(1) The Secretary shall hold public hearings in the vicinity of each site under consideration for recommendation to the President under this paragraph as a site for the development of a repository, for the purposes of informing the residents of the area in which such site is located of such consideration and receiving their comments regarding the possible recommendation of such site. If, upon completion of such hearings and completion of site characterization activities at not less than 3 candidate sites for the first proposed repository, or from all of the characterized sites for the development of subsequent respositories, under section 113, the Secretary decides to recommend approval of such site to the President, the Secretary shall notify the Governor and legislature of the State in which such site is located, or the governing body of the affected Indian tribe where such site is located, as the case may be, of such decision. No sooner than the expiration of the 30-day period following such notification, the Secretary shall submit to the President a recommendation that the President approve such site for the development of a repository. Any such recommendation by the Secretary shall be based on the record of information developed by the Secretary under section 113 and this section, including the information described in subparagraph (A) through subparagraph (G). In making site recommendations and approvals subsequent to the first site recommendation, the Secretary and the President, respectively, shall also consider the need for regional distribution of repositories and the need to minimize, to the extent practicable, the impacts and cost of transporting spent fuel and solidified high-level radioactive waste. Together with any recommendation of a site under this paragraph, the Secretary shall make available to the public, and submit to the President, a comprehensive statement of the basis of such recommendation, including the following:

42 USC 10134.

Notification of decision

Public availability

(A) a description of the proposed repository, including preliminary engineering specifications for the facility;

(B) a description of the waste form or packaging proposed for use at such repository, and an explanation of the relationship between such waste form or packaging and the geologic medium of such site;

(C) a discussion of data, obtained in site characterization activities, relating to the safety of such site;

(D) a final environmental impact statement prepared pursuant to subsection (f) and the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), including an analysis of the consideration given by the Secretary to not less than 3 candidate sites for the first proposed respository or to all of the characterized sites for the development of subsequent repositories, with respect to which site characterization is completed under section 113, together with comments made concerning such environmental impact statement by the Secretary of the Interior, the Council on Environmental Quality, the Administrator, and the Commission, except that any such environmental impact statement concerning the first repository to be developed under this Act shall not be required to consider the need for a repository or the alternatives to geologic disposal;

(E) preliminary comments of the Commission concerning the extent to which the at-depth site characterization analysis and

the waste form proposal for such site seem to be sufficient for inclusion in any application to be submitted by the Secretary for licensing of such site as a repository;

(F) the views and comments of the Governor and legislature of any State, or the governing body of any affected Indian tribe, as determined by the Secretary, together with the response of the Secretary to such views;

(G) such other information as the Secretary considers appropriate; and

(H) any impact report submitted under section 116(c)(2)(B) by the State in which such site is located, or under section 118(b)(3)(B) by the affected Indian tribe where such site is located, as the case may be.

Submittal to Congress.

(2)(A) Not later than March 31, 1987, the President shall submit to the Congress a recommendation of one site from the three sites initially characterized that the President considers qualified for application for a construction authorization for a repository. Not later than March 31, 1990, the President shall submit to the Congress a recommendation of a second site from any sites already characterized that the President considers qualified for a construction authorization for a second repository. The President shall submit with such recommendation a copy of the report for such site prepared by the Secretary under paragraph (1). After submission of the second such recommendation, the President may submit to the Congress recommendations for other sites, in accorance with the provisions of this subtitle.

Deadlines, extensions.

(B) The President may extend the deadlines described in subparagraph (A) by not more than 12 months if, before March 31, 1986, for the first site, and March 31, 1989, for the second site, (i) the President determines that such extension is necessary; and (ii) transmits to the Congress a report setting forth the reasons for such extension.

Submittal to Congress.

(3) If approval of any such site recommendation does not take effect as a result of a disapproval by the Governor or legislature of a State under section 116 or the governing body of an affected Indian tribe under section 118, the President shall submit to the Congress, not later than 1 year after the disapproval of such recommendation, a recommendation of another site for the first or subsequent repository.

(4)(A) The President may not recommend the approval of any site under this subsection unless the Secretary has recommended to the President under paragraph (1) approval of such site and has submitted to the President a report for such site as required under such paragraph.

(B) No recommendation of a site by the President under this subsection shall require the preparation of an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)), or to require any environmental review under subparagraph (E) or (F) of section 102(2) of such Act.

(b) SUBMISSION OF APPLICATION.—If the President recommends to the Congress a site for a repository under subsection (a) and the site designation is permitted to take effect under section 115, the Secretary shall submit to the Commission an application for a construction authorization for a repository at such site not later than 90 days after the date on which the recommendation of the site designation is effective under such section and shall provide to the Governor and

legislature of the State in which such site is located, or the governing body of the affected Indian tribe where such site is located, as the case may be, a copy of such application.

(c) STATUS REPORT ON APPLICATION.—Not later than 1 year after the date on which an application for a construction authorization is submitted under subsection (b), and annually thereafter until the date on which such authorization is granted, the Commission shall submit a report to the Congress describing the proceedings undertaken through the date of such report with regard to such application, including a description of—

(1) any major unresolved safety issues, and the explanation of the Secretary with respect to design and operation plans for resolving such issues;

(2) any matters of contention regarding such application; and

(3) any Commission actions regarding the granting or denial of such authorization.

Construction authorization application

(d) COMMISSION ACTION.—The Commission shall consider an application for a construction authorization for all or part of a repository in accordance with the laws applicable to such applications, except that the Commission shall issue a final decision approving or disapproving the issuance of a construction authorization not later than—

(1) January 1, 1989, for the first such application, and January 1, 1992, for the second such application; or

(2) the expiration of 3 years after the date of the submission of such application, except that the Commission may extend such deadline by not more than 12 months if, not less than 30 days before such deadline, the Commission complies with the reporting requirements established in subsection (e)(2);

whichever occurs later. The Commission decision approving the first such application shall prohibit the emplacement in the first repository of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent fuel until such time as a second repository is in operation. In the event that a monitored retrievable storage facility, approved pursuant to subtitle C of this Act, shall be located, or is planned to be located, within 50 miles of the first repository, then the Commission decision approving the first such application shall prohibit the emplacement of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing of spent fuel in both the repository and monitored retrievable storage facility until such time as a second repository is in operation.

(e) PROJECT DECISION SCHEDULE.—(1) The Secretary shall prepare and update, as appropriate, in cooperation with all affected Federal agencies, a project decision schedule that portrays the optimum way to attain the operation of the repository involved, within the time periods specified in this subtitle. Such schedule shall include a description of objectives and a sequence of deadlines for all Federal agencies required to take action, including an identification of the activities in which a delay in the start, or completion, of such activities will cause a delay in beginning repository operation.

Report submittal to Secretary and Congress

(2) Any Federal agency that determines that it cannot comply with any deadline in the project decision schedule, or fails to so comply, shall submit to the Secretary and to the Congress a written report explaining the reason for its failure or expected failure to

meet such deadline, the reason why such agency could not reach an agreement with the Secretary, the estimated time for completion of the activity or activities involved, the associated effect on its other deadlines in the project decision schedule, and any recommendations it may have or actions it intends to take regarding any improvements in its operation or organization, or changes to its statutory directives or authority, so that it will be able to mitigate the delay involved. The Secretary, within 30 days after receiving any such report, shall file with the Congress his response to such report, including the reasons why the Secretary could not amend the project decision schedule to accommodate the Federal agency involved.

Report response, filing with Congress.

(f) ENVIRONMENTAL IMPACT STATEMENT.—Any recommendation made by the Secretary under this section shall be considered a major Federal action significantly affecting the quality of the human environment for purposes of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.). A final environmental impact statement prepared by the Secretary under such Act shall accompany any recommendation to the President to approve a site for a repository. With respect to the requirements imposed by the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), compliance with the procedures and requirements of this Act shall be deemed adequate consideration of the need for a repository, the time of the initial availability of a repository, and all alternatives to the isolation of high-level radioactive waste and spent nuclear fuel in a repository. For purposes of complying with the requirements of the National Environmental Policy Act of 1969 (42 U.S.C. 1321 et seq.) and this section, the Secretary shall consider as alternate sites for the first repository to be developed under this subtitle 3 candidate sites with respect to which (1) site characterization has been completed under section 113; and (2) the Secretary has made a preliminary determination, that such sites are suitable for development as respositories consistent with the guidelines promulgated under section 112(a). The Secretary shall consider as alternative sites for subsequent repositories at least three of the remaining sites recommended by the Secretary by January 1, 1985, and by July 1, 1989, pursuant to section 112(b) and approved by the President for site characterization pursuant to section 112(c) for which (1) site characterization has been completed under section 113; and (2) the Secretary has made a preliminary determination that such sites are suitable for development as respositories consistent with the guidelines promulgated under section 112(a). Any environmental impact statement prepared in connection with a repository proposed to be constructed by the Secretary under this subtitle shall, to the extent practicable, be adopted by the Commission in connection with the issuance by the Commission of a construction authorization and license for such repository. To the extent such statement is adopted by the Commission, such adoption shall be deemed to also satisfy the responsibilities of the Commission under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) and no further consideration shall be required, except that nothing in this subsection shall affect any independent responsibilities of the Commission to protect the public health and safety under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.). Nothing in this Act shall be construed to amend or otherwise detract from the licensing requirements of the Nucler Regulatory Commission as established in title II of the Energy Reorganization Act of 1974 (Public Law 93-438). In

42 USC 4321 *et seq.*

42 USC 5841.

any such statement prepared with respect to the first repository to be constructed under this subtitle, the need for a repository or nongeologic alternatives to the site of such repository shall not be considered.

REVIEW OF REPOSITORY SITE SELECTION

SEC. 115. (a) DEFINITION.—For purposes of this section, the term "resolution of repository siting approval" means a joint resolution of the Congress, the matter after the resolving clause of which is as follows: "That there hereby is approved the site at ..... for a repository, with respect to which a notice of disapproval was submitted by ..... on .....". The first blank space in such resolution shall be filled with the name of the geographic location of the proposed site of the repository to which such resolution pertains; the second blank space in such resolution shall be filled with the designation of the State Governor and legislature or Indian tribe governing body submitting the notice of disapproval to which such resolution pertains; and the last blank space in such resolution shall be filled with the date of such submission. 42 USC 10135.

(b) STATE OR INDIAN TRIBE PETITIONS.—The designation of a site as suitable for application for a construction authorization for a repository shall be effective at the end of the 60-day period beginning on the date that the President recommends such site to the Congress under section 114, unless the Governor and legislature of the State in which such site is located, or the governing body of an Indian tribe on whose reservation such site is located, as the case may be, has submitted to the Congress a notice of disapproval under section 116 or 118. If any such notice of disapproval has been submitted, the designation of such site shall not be effective except as provided under subsection (c). Notice of disapproval, submittal to Congress.

(c) CONGRESSIONAL REVIEW OF PETITIONS.—If any notice of disapproval of a repository site designation has been submitted to the Congress under section 116 or 118 after a recommendation for approval of such site is made by the President under section 114, such site shall be disapproved unless, during the first period of 90 calendar days of continuous session of the Congress after the date of the receipt by the Congress of such notice of disapproval, the Congress passes a resolution of repository siting approval in accordance with this subsection approving such site, and such resolution thereafter becomes law.

(d) PROCEDURES APPLICABLE TO THE SENATE.—(1) The provisions of this subsection are enacted by the Congress—

(A) as an exercise of the rulemaking power of the Senate, and as such they are deemed a part of the rules of the Senate, but applicable only with respect to the procedure to be followed in the Senate in the case of resolutions of repository siting approval, and such provisions supersede other rules of the Senate only to the extent that they are inconsistent with such other rules; and

(B) with full recognition of the constitutional right of the Senate to change the rules (so far as relating to the procedure of the Senate) at any time, in the same manner and to the same extent as in the case of any other rule of the Senate.

(2)(A) Not later than the first day of session following the day on which any notice of disapproval of a repository site selection is submitted to the Congress under section 116 or 118, a resolution of Introduction of resolution

repository siting approval shall be introduced (by request) in the Senate by the chairman of the committee to which such notice of disapproval is referred, or by a Member or Members of the Senate designated by such chairman.

Committee recommendations.

(B) Upon introduction, a resolution of repository siting approval shall be referred to the appropriate committee or committees of the Senate by the President of the Senate, and all such resolutions with respect to the same repository site shall be referred to the same committee or committees. Upon the expiration of 60 calendar days of continuous session after the introduction of the first resolution of repository siting approval with respect to any site, each committee to which such resolution was referred shall make its recommendations to the Senate.

Discharge of committee.

(3) If any committee to which is referred a resolution of siting approval introduced under paragraph (2)(A), or, in the absence of such a resolution, any other resolution of siting approval introduced with respect to the site involved, has not reported such resolution at the end of 60 days of continuous session of Congress after introduction of such resolution, such committee shall be deemed to be discharged from further consideration of such resolution, and such resolution shall be placed on the appropriate calendar of the Senate.

(4)(A) When each committee to which a resolution of siting approval has been referred has reported, or has been deemed to be discharged from further consideration of, a resolution described in paragraph (3), it shall at any time thereafter be in order (even though a previous motion to the same effect has been disagreed to) for any Member of the Senate to move to proceed to the consideration of such resolution. Such motion shall be highly privileged and shall not be debatable. Such motion shall not be subject to amendment, to a motion to postpone, or to a motion to proceed to the consideration of other business. A motion to reconsider the vote by which such motion is agreed to or disagreed to shall not be in order. If a motion to proceed to the consideration of such resolution is agreed to, such resolution shall remain the unfinished business of the Senate until disposed of.

Debate.

(B) Debate on a resolution of siting approval, and on all debatable motions and appeals in connection with such resolution, shall be limited to not more than 10 hours, which shall be divided equally between Members favoring and Members opposing such resolution. A motion further to limit debate shall be in order and shall not be debatable. Such motion shall not be subject to amendment, to a motion to postpone, or to a motion to proceed to the consideration of other business, and a motion to recommit such resolution shall not be in order. A motion to reconsider the vote by which such resolution is agreed to or disagreed to shall not be in order.

(C) Immediately following the conclusion of the debate on a resolution of siting approval, and a single quorum call at the conclusion of such debate if requested in accordance with the rules of the Senate, the vote on final approval of such resolution shall occur.

Appeals.

(D) Appeals from the decisions of the Chair relating to the application of the rules of the Senate to the procedure relating to a resolution of siting approval shall be decided without debate.

(5) If the Senate receives from the House a resolution of repository siting approval with respect to any site, then the following procedure shall apply:

(A) The resolution of the House with respect to such site shall not be referred to a committee.

(B) With respect to the resolution of the Senate with respect to such site—

(i) the procedure with respect to that or other resolutions of the Senate with respect to such site shall be the same as if no resolution from the House with respect to such site had been received; but

(ii) on any vote on final passage of a resolution of the Senate with respect to such site, a resolution from the House with respect to such site where the text is identical shall be automatically substituted for the resolution of the Senate.

(e) PROCEDURES APPLICABLE TO THE HOUSE OF REPRESENTATIVES.—(1) The provisions of this section are enacted by the Congress—

(A) as an exercise of the rulemaking power of the House of Representatives, and as such they are deemed a part of the rules of the House, but applicable only with respect to the procedure to be followed in the House in the case of resolutions of repository siting approval, and such provisions supersede other rules of the House only to the extent that they are inconsistent with such other rules; and

(B) with full recognition of the constitutional right of the House to change the rules (so far as relating to the procedure of the House) at any time, in the same manner and to the same extent as in the case of any other rule of the House.

(2) Resolutions of repository siting approval shall upon introduction, be immediately referred by the Speaker of the House to the appropriate committee or committees of the House. Any such resolution received from the Senate shall be held at the Speaker's table.

Discharge of committee

(3) Upon the expiration of 60 days of continuous session after the introduction of the first resolution of repository siting approval with respect to any site, each committee to which such resolution was referred shall be discharged from further consideration of such resolution, and such resolution shall be referred to the appropriate calendar, unless such resolution or an identical resolution was previously reported by each committee to which it was referred.

Resolution, consideration and debate

(4) It shall be in order for the Speaker to recognize a Member favoring a resolution to call up a resolution of repository siting approval after it has been on the appropriate calendar for 5 legislative days. When any such resolution is called up, the House shall proceed to its immediate consideration and the Speaker shall recognize the Member calling up such resolution and a Member opposed to such resolution for 2 hours of debate in the House, to be equally divided and controlled by such Members. When such time has expired, the previous question shall be considered as ordered on the resolution to adoption without intervening motion. No amendment to any such resolution shall be in order, nor shall it be in order to move to reconsider the vote by which such resolution is agreed to or disagreed to.

(5) If the House receives from the Senate a resolution of repository siting approval with respect to any site, then the following procedure shall apply:

(A) The resolution of the Senate with respect to such site shall not be referred to a committee.

(B) With respect to the resolution of the House with respect to such site—

(i) the procedure with respect to that or other resolutions of the House with respect to such site shall be the same as if no resolution from the Senate with respect to such site had been received; but

(ii) on any vote on final passage of a resolution of the House with respect to such site, a resolution from the Senate with respect to such site where the text is identical shall be automatically substituted for the resolution of the House.

(f) COMPUTATION OF DAYS.—For purposes of this section—

(1) continuity of session of Congress is broken only by an adjournment sine die; and

(2) the days on which either House is not in session because of an adjournment of more than 3 days to a day certain are excluded in the computation of the 90-day period referred to in subsection (c) and the 60-day period referred to in subsections (d) and (e).

(g) INFORMATION PROVIDED TO CONGRESS.—In considering any notice of disapproval submitted to the Congress under section 116 or 118, the Congress may obtain any comments of the Commission with respect to such notice of disapproval. The provision of such comments by the Commission shall not be construed as binding the Commission with respect to any licensing or authorization action concerning the repository involved.

PARTICIPATION OF STATES

42 USC 10136.

SEC. 116. (a) NOTIFICATION OF STATES AND AFFECTED TRIBES.—The Secretary shall identify the States with one or more potentially acceptable sites for a repository within 90 days after the date of enactment of this Act. Within 90 days of such identification, the Secretary shall notify the Governor, the State legislature, and the tribal council of any affected Indian tribe in any State of the potentially acceptable sites within such State. For the purposes of this title, the term "potentially acceptable site" means any site at which, after geologic studies and field mapping but before detailed geologic data gathering, the Department undertakes preliminary drilling and geophysical testing for the definition of site location.

"Potentially acceptable site."

(b) STATE PARTICIPATION IN REPOSITORY SITING DECISIONS.—(1) Unless otherwise provided by State law, the Governor or legislature of each State shall have authority to submit a notice of disapproval to the Congress under paragraph (2). In any case in which State law provides for submission of any such notice of disapproval by any other person or entity, any reference in this subtitle to the Governor or legislature of such State shall be considered to refer instead to such other person or entity.

Notice of disapproval, submittal to Congress.

(2) Upon the submission by the President to the Congress of a recommendation of a site for a repository, the Governor or legislature of the State in which such site is located may disapprove the site designation and submit to the Congress a notice of disapproval. Such Governor or legislature may submit such a notice of disapproval to the Congress not later than the 60 days after the date that the President recommends such site to the Congress under section 114. A notice of disapproval shall be considered to be submitted to the Congress on the date of the transmittal of such notice of disapproval to the Speaker of the House and the President pro tempore of the Senate. Such notice of disapproval shall be accompanied by a state-

ment of reasons explaining why such Governor or legislature disapproved the recommended repository site involved.

(3) The authority of the Governor or legislature of each State under this subsection shall not be applicable with respect to any site located on a reservation.

(c) FINANCIAL ASSISTANCE.—(1)(A) The Secretary shall make grants to each State notified under subsection (a) for the purpose of participating in activities required by sections 116 and 117 or authorized by written agreement entered into pursuant to subsection 117(c). Any salary or travel expense that would ordinarily be incurred by such State, or by any political subdivision of such State, may not be considered eligible for funding under this paragraph. Grants.

(B) The Secretary shall make grants to each State in which a candidate site for a repository is approved under section 112(c). Such grants may be made to each such State only for purposes of enabling such State—

(i) to review activities taken under this subtitle with respect to such site for purposes of determining any potential economic, social, public health and safety, and environmental impacts of such repository on the State and its residents;

(ii) to develop a request for impact assistance under paragraph (2);

(iii) to engage in any monitoring, testing, or evaluation activities with respect to site characterization programs with regard to such site;

(iv) to provide information to its residents regarding any activities of such State, the Secretary, or the Commission with respect to such site; and

(v) to request information from, and make comments and recommendations to, the Secretary regarding any activities taken under this subtitle with respect to such site.

(C) Any salary or travel expense that would ordinarily be incurred by such State, or by any political subdivision of such State, may not be considered eligible for funding under this paragraph.

(2)(A) The Secretary shall provide financial and technical assistance to any State requesting such assistance in which there is a site with respect to which the Commission has authorized construction of a repository. Such assistance shall be designed to mitigate the impact on such State of the development of such repository. Such assistance to such State shall commence within 6 months following the granting by the Commission of a construction authorization for such repository and following the initiation of construction activities at such site. Construction authorization.

(B) Any State desiring assistance under this paragraph shall prepare and submit to the Secretary a report on any economic, social, public health and safety, and environmental impacts that are likely as a result of the development of a repository at a site in such State. Such report shall be submitted to the Secretary following the completion of site characterization activities at such site and before the recommendation of such site to the President by the Secretary for application for a construction authorization for a repository. As soon as practicable following the granting of a construction authorization for such repository, the Secretary shall seek to enter into a binding agreement with the State involved setting forth the amount of assistance to be provided to such State under this paragraph and the procedures to be followed in providing such assistance. Report submittal.

(3) The Secretary shall also grant to each State and unit of general local government in which a site for a repository is approved under section 112(c) an amount each fiscal year equal to the amount such State and unit of general local government, respectively, would receive were they authorized to tax site characterization activities at such site, and the development and operation of such repository, as such State and unit of general local government tax the other real property and industrial activities occurring within such State and unit of general local government. Such grants shall continue until such time as all such activities, development, and operation are terminated at such site.

Grants, limitations.

(4)(A) A State may not receive any grant under paragraph (1) after the expiration of the 1-year period following—

(i) the date on which the Secretary notifies the Governor and legislature of the State involved of the termination of site characterization activities at the candidate site involved in such State;

(ii) the date on which the site in such State is disapproved under section 115; or

(iii) the date on which the Commission disapproves an application for a construction authorization for a repository at such site;

whichever occurs first, unless there is another candidate site in the State approved under section 112(c) with respect to which the actions described in clauses (i), (ii), and (iii) have not been taken.

(B) A State may not receive any further assistance under paragraph (2) with respect to a site if repository construction activities at such site are terminated by the Secretary or if such activities are permanently enjoined by any court.

Funding limitations.

(C) At the end of the 2-year period beginning on the effective date of any license to receive and possess for a repository in a State, no Federal funds shall be made available to such State under paragraph (1) or (2), except for—

(i) such funds as may be necessary to support State activities related to any other repository located in, or proposed to be located in, such State, and for which a license to receive and possess has not been in effect for more than 1 year; and

(ii) such funds as may be necessary to support State activities pursuant to agreements or contracts for impact assistance entered into, under paragraph (2), by such State with the Secretary during such 2-year period.

(5) Financial assistance authorized in this subsection shall be made out of amounts held in the Nuclear Waste Fund established in section 302.

Post, p. 2257.

(d) ADDITIONAL NOTIFICATION AND CONSULTATION.—Whenever the Secretary is required under any provision of this Act to notify or consult with the governing body of an affected Indian tribe where a site is located, the Secretary shall also notify or consult with, as the case may be, the Governor of the State in which such reservation is located.

CONSULTATION WITH STATES AND AFFECTED INDIAN TRIBES

42 USC 10137.

SEC. 117. (a) PROVISION OF INFORMATION.—(1) The Secretary, the Commission, and other agencies involved in the construction, operation, or regulation of any aspect of a repository in a State shall provide to the Governor and legislature of such State, and to the

governing body of any affected Indian tribe, timely and complete information regarding determinations or plans made with respect to the site characterization siting, development, design, licensing, construction, operation, regulation, or decommissioning of such repository.

Information request, response.

(2) Upon written request for such information by the Governor or legislature of such State, or by the governing body of any affected Indian tribe, as the case may be, the Secretary shall provide a written response to such request within 30 days of the receipt of such request. Such response shall provide the information requested or, in the alternative, the reasons why the information cannot be so provided. If the Secretary fails to so respond within such 30 days, the Governor or legislature of such State, or the governing body of any affected Indian tribe, as the case may be, may transmit a formal written objection to such failure to respond to the President. If the President or Secretary fails to respond to such written request within 30 days of the receipt by the President of such formal written objection, the Secretary shall immediately suspend all activities in such State authorized by this subtitle, and shall not renew such activities until the Governor or legislature of such State, or the governing body of any affected Indian tribe, as the case may be, has received the written response to such written request required by this subsection.

(b) CONSULTATION AND COOPERATION.—In performing any study of an area within a State for the purpose of determining the suitability of such area for a repository pursuant to section 112(c), and in subsequently developing and loading any repository within such State, the Secretary shall consult and cooperate with the Governor and legislature of such State and the governing body of any affected Indian tribe in an effort to resolve the concerns of such State and any affected Indian tribe regarding the public health and safety, environmental, and economic impacts of any such repository. In carrying out his duties under this subtitle, the Secretary shall take such concerns into account to the maximum extent feasible and as specified in written agreements entered into under subsection (c).

(c) WRITTEN AGREEMENT.—Not later than 60 days after (1) the approval of a site for site characterization for such a repository under section 112(c), or (2) the written request of the State or Indian tribe in any affected State notified under section 116(a) to the Secretary, whichever, first occurs, the Secretary shall seek to enter into a binding written agreement, and shall begin negotiations, with such State and, where appropriate, to enter into a separate binding agreement with the governing body of any affected Indian tribe, setting forth (but not limited to) the procedures under which the requirements of subsections (a) and (b), and the provisions of such written agreement, shall be carried out. Any such written agreement shall not affect the authority of the Commission under existing law. Each such written agreement shall, to the maximum extent feasible, be completed not later than 6 months after such notification. If such written agreement is not completed within such period, the Secretary shall report to the Congress in writing within 30 days on the status of negotiations to develop such agreement and the reasons why such agreement has not been completed. Prior to submission of such report to the Congress, the Secretary shall transmit such report to the Governor of such State or the governing body of such affected Indian tribe, as the case may be, for their review and comments. Such comments shall be included in such

Report to Congress.

Report, review and comments

report prior to submission to the Congress. Such written agreement shall specify procedures—

(1) by which such State or governing body of an affected Indian tribe, as the case may be, may study, determine, comment on, and make recommendations with regard to the possible public health and safety, environmental, social, and economic impacts of any such repository;

(2) by which the Secretary shall consider and respond to comments and recommendations made by such State or governing body of an affected Indian tribe, including the period in which the Secretary shall so respond;

Review and modification.

(3) by which the Secretary and such State or governing body of an affected Indian tribe may review or modify the agreement periodically;

Report.

(4) by which such State or governing body of an affected Indian tribe is to submit an impact report and request for impact assistance under section 116(c) or section 118(b), as the case may be;

(5) by which the Secretary shall assist such State, and the units of general local government in the vicinity of the repository site, in resolving the offsite concerns of such State and units of general local government, including, but not limited to, questions of State liability arising from accidents, necessary road upgrading and access to the site, ongoing emergency preparedness and emergency response, monitoring of transportation of high-level radioactive waste and spent nuclear fuel through such State, conduct of baseline health studies of inhabitants in neighboring communities near the repository site and reasonable periodic monitoring thereafter, and monitoring of the repository site upon any decommissioning and decontamination;

(6) by which the Secretary shall consult and cooperate with such State on a regular, ongoing basis and provide for an orderly process and timely schedule for State review and evaluation, including identification in the agreement of key events, milestones, and decision points in the activities of the Secretary at the potential repository site;

Transportation of radioactive waste and spent nuclear fuel, State notification.

(7) by which the Secretary shall notify such State prior to the transportation of any high-level radioactive waste and spent nuclear fuel into such State for disposal at the repository site;

Monitoring and testing.

(8) by which such State may conduct reasonable independent monitoring and testing of activities on the repository site, except that such monitoring and testing shall not unreasonably interfere with or delay onsite activities;

(9) for sharing, in accordance with applicable law, of all technical and licensing information, the utilization of available expertise, the facilitating of permit procedures, joint project review, and the formulation of joint surveillance and monitoring arrangements to carry out applicable Federal and State laws;

(10) for public notification of the procedures specified under the preceding paragraphs; and

(11) for resolving objections of a State and affected Indian tribes at any stage of the planning, siting, development, construction, operation, or closure of such a facility within such State through negotiation, arbitration, or other appropriate mechanisms.

PARTICIPATION OF INDIAN TRIBES

SEC. 118. (a) PARTICIPATION OF INDIAN TRIBES IN REPOSITORY SITING DECISIONS.—Upon the submission by the President to the Congress of a recommendation of a site for a repository located on the reservation of an affected Indian tribe, the governing body of such Indian tribe may disapprove the site designation and submit to the Congress a notice of disapproval. The governing body of such Indian tribe may submit such a notice of disapproval to the Congress not later than the 60 days after the date that the President recommends such site to the Congress under section 114. A notice of disapproval shall be considered to be submitted to the Congress on the date of the transmittal of such notice of disapproval to the Speaker of the House and the President pro tempore of the Senate. Such notice of disapproval shall be accompanied by a statement of reasons explaining why the governing body of such Indian tribe disapproved the recommended repository site involved.

Notice of disapproval, submittal to Congress 42 USC 10138.

(b) FINANCIAL ASSISTANCE.—(1) The Secretary shall make grants to each affected tribe notified under section 116(a) for the purpose of participating in activities required by section 117 or authorized by written agreement entered into pursuant to section 117(c). Any salary or travel expense that would ordinarily be incurred by such tribe, may not be considered eligible for funding under this paragraph.

Grants.

(2)(A) The Secretary shall make grants to each affected Indian tribe where a candidate site for a repository is approved under section 112(c). Such grants may be made to each such Indian tribe only for purposes of enabling such Indian tribe—

(i) to review activities taken under this subtitle with respect to such site for purposes of determining any potential economic, social, public health and safety, and environmental impacts of such repository on the reservation and its residents;

(ii) to develop a request for impact assistance under paragraph (2);

(iii) to engage in any monitoring, testing, or evaluation activities with respect to site characterization programs with regard to such site;

(iv) to provide information to the residents of its reservation regarding any activities of such Indian tribe, the Secretary, or the Commission with respect to such site; and

(v) to request information from, and make comments and recommendations to, the Secretary regarding any activities taken under this subtitle with respect to such site.

(B) The amount of funds provided to any affected Indian tribe under this paragraph in any fiscal year may not exceed 100 percent of the costs incurred by such Indian tribe with respect to the activities described in clauses (i) through (v) of subparagraph (A). Any salary or travel expense that would ordinarily be incurred by such Indian tribe may not be considered eligible for funding under this paragraph.

(3)(A) The Secretary shall provide financial and technical assistance to any affected Indian tribe requesting such assistance and where there is a site with respect to which the Commission has authorized construction of a repository. Such assistance shall be designed to mitigate the impact on such Indian tribe of the development of such repository. Such assistance to such Indian tribe shall commence within 6 months following the granting by the Commis-

sion of a construction authorization for such repository and following the initiation of construction activities at such site.

Report submittal.

(B) Any affected Indian tribe desiring assistance under this paragraph shall prepare and submit to the Secretary a report on any economic, social, public health and safety, and environmental impacts that are likely as a result of the development of a repository at a site on the reservation of such Indian tribe. Such report shall be submitted to the Secretary following the completion of site characterization activities at such site and before the recommendation of such site to the President by the Secretary for application for a construction authorization for a repository. As soon as practicable following the granting of a construction authorization for such repository, the Secretary shall seek to enter into a binding agreement with the Indian tribe involved setting forth the amount of assistance to be provided to such Indian tribe under this paragraph and the procedures to be followed in providing such assistance.

(4) The Secretary shall grant to each affected Indian tribe where a site for a repository is approved under section 112(c) an amount each fiscal year equal to the amount such Indian tribe would receive were it authorized to tax site characterization activities at such site, and the development and operation of such repository, as such Indian tribe taxes the other commercial activities occurring on such reservation. Such grants shall continue until such time as all such activities, development, and operation are terminated at such site.

Grants, limitation.

(5) An affected Indian tribe may not receive any grant under paragraph (1) after the expiration of the 1-year period following—

(i) the date on which the Secretary notifies such Indian tribe of the termination of site characterization activities at the candidate site involved on the reservation of such Indian tribe;

(ii) the date on which such site is disapproved under section 115; or

(iii) the date on which the Commission disapproves an application for a construction authorization for a repository at such site;

whichever occurs first, unless there is another candidate site on the reservation of such Indian tribe that is approved under section 112(c) and with respect to which the actions described in clauses (i), (ii), and (iii) have not been taken.

(B) An affected Indian tribe may not receive any further assistance under paragraph (2) with respect to a site if repository construction activities at such site are terminated by the Secretary or if such activities are permanently enjoined by any court.

Funding.

(C) At the end of the 2-year period beginning on the effective date of any license to receive and possess for a repository at a site on the reservation of an affected Indian tribe, no Federal funds shall be made available under paragraph (1) or (2) to such Indian tribe, except for—

(i) such funds as may be necessary to support activities of such Indian tribe related to any other repository where a license to receive and possess has not been in effect for more than 1 year; and

(ii) such funds as may be necessary to support activities of such Indian tribe pursuant to agreements or contracts for impact assistance entered into, under paragraph (2), by such Indian tribe with the Secretary during such 2-year period.

(6) Financial assistance authorized in this subsection shall be made out of amounts held in the Nuclear Waste Fund established in section 302. *Post*, p. 2257.

JUDICIAL REVIEW OF AGENCY ACTIONS

SEC. 119. (a) JURISDICTION OF UNITED STATES COURTS OF APPEALS.— 42 USC 10139
(1) Except for review in the Supreme Court of the United States, the United States courts of appeals shall have original and exclusive jurisdiction over any civil action—

(A) for review of any final decision or action of the Secretary, the President, or the Commission under this subtitle;

(B) alleging the failure of the Secretary, the President, or the Commission to make any decision, or take any action, required under this subtitle;

(C) challenging the constitutionality of any decision made, or action taken, under any provision of this subtitle;

(D) for review of any environmental impact statement prepared pursuant to the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) with respect to any action under this subtitle, or as required under section 135(c)(1), or alleging a failure to prepare such statement with respect to any such action;

(E) for review of any environmental assessment prepared under section 112(b)(1) or 135(c)(2); or

(F) for review of any research and development activity under title II. *Post*, p. 2245.

(2) The venue of any proceeding under this section shall be in the judicial circuit in which the petitioner involved resides or has its principal office, or in the United States Court of Appeals for the District of Columbia.

(c) DEADLINE FOR COMMENCING ACTION.—A civil action for judicial review described under subsection (a)(1) may be brought not later than the 180th day after the date of the decision or action or failure to act involved, as the case may be, except that if a party shows that he did not know of the decision or action complained of (or of the failure to act), and that a reasonable person acting under the circumstances would not have known, such party may bring a civil action not later than the 180th day after the date such party acquired actual or constructive knowledge of such decision, action, or failure to act.

EXPEDITED AUTHORIZATIONS

SEC. 120. (a) ISSUANCE OF AUTHORIZATIONS.—(1) To the extent that 42 USC 10140.
the taking of any action related to the site characterization of a site or the construction or initial operation of a repository under this subtitle requires a certificate, right-of-way, permit, lease, or other authorization from a Federal agency or officer, such agency or officer shall issue or grant any such authorization at the earliest practicable date, to the extent permitted by the applicable provisions of law administered by such agency or officer. All actions of a Federal agency or officer with respect to consideration of applications or requests for the issuance or grant of any such authorization shall be expedited, and any such application or request shall take precedence over any similar applications or requests not related to such repositories.

(2) The provisions of paragraph (1) shall not apply to any certificate, right-of-way, permit, lease, or other authorization issued or granted by, or requested from, the Commission.

(b) TERMS OF AUTHORIZATIONS.—Any authorization issued or granted pursuant to subsection (a) shall include such terms and conditions as may be required by law, and may include terms and conditions permitted by law.

CERTAIN STANDARDS AND CRITERIA

42 USC 10141.

SEC. 121. (a) ENVIRONMENTAL PROTECTION AGENCY STANDARDS.—Not later than 1 year after the date of the enactment of this Act, the Administrator, pursuant to authority under other provisions of law, shall, by rule, promulgate generally applicable standards for protection of the general environment from offsite releases from radioactive material in repositories.

(b) COMMISSION REQUIREMENTS AND CRITERIA.—(1)(A) Not later than January 1, 1984, the Commission, pursuant to authority under other provisions of law, shall, by rule, promulgate technical requirements and criteria that it will apply, under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) and the Energy Reorganization Act of 1974 (42 U.S.C. 5801 et seq.), in approving or disapproving—

(i) applications for authorization to construct repositories;

(ii) applications for licenses to receive and possess spent nuclear fuel and high-level radioactive waste in such repositories; and

(iii) applications for authorization for closure and decommissioning of such repositories.

(B) Such criteria shall provide for the use of a system of multiple barriers in the design of the repository and shall include such restrictions on the retrievability of the solidified high-level radioactive waste and spent fuel emplaced in the repository as the Commission deems appropriate.

(C) Such requirements and criteria shall not be inconsistent with any comparable standards promulgated by the Administrator under subsection (a).

(2) For purposes of this Act, nothing in this section shall be construed to prohibit the Commission from promulgating requirements and criteria under paragraph (1) before the Administrator promulgates standards under subsection (a). If the Administrator promulgates standards under subsection (a) after requirements and criteria are promulgated by the Commission under paragraph (1), such requirements and criteria shall be revised by the Commission if necessary to comply with paragraph (1)(C).

(c) ENVIRONMENTAL IMPACT STATEMENT.—The promulgation of standards or criteria in accordance with the provisions of this section shall not require the preparation of an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)), or to require any environmental review under subparagraph (E) or (F) of section 102(2) of such Act.

DISPOSAL OF SPENT NUCLEAR FUEL

42 USC 10142.

SEC. 122. Notwithstanding any other provision of this subtitle, any repository constructed on a site approved under this subtitle shall be designed and constructed to permit the retrieval of any spent

nuclear fuel placed in such repository, during an appropriate period of operation of the facility, for any reason pertaining to the public health and safety, or the environment, or for the purpose of permitting the recovery of the economically valuable contents of such spent fuel. The Secretary shall specify the appropriate period of retrievability with respect to any repository at the time of design of such repository, and such aspect of such repository shall be subject to approval or disapproval by the Commission as part of the construction authorization process under subsections (b) through (d) of section 114.

TITLE TO MATERIAL

SEC. 123. Delivery, and acceptance by the Secretary, of any high-level radioactive waste or spent nuclear fuel for a repository constructed under this subtitle shall constitute a transfer to the Secretary of title to such waste or spent fuel. 42 USC 10143.

CONSIDERATION OF EFFECT OF ACQUISITION OF WATER RIGHTS

SEC. 124. The Secretary shall give full consideration to whether the development, construction, and operation of a repository may require any purchase or other acquisition of water rights that will have a significant adverse effect on the present or future development of the area in which such repository is located. The Secretary shall mitigate any such adverse effects to the maximum extent practicable. 42 USC 10144.

TERMINATION OF CERTAIN PROVISIONS

SEC. 125. Sections 119 and 120 shall cease to have effect at such time as a repository developed under this subtitle is licensed to receive and possess high-level radioactive waste and spent nuclear fuel. 42 USC 10145.

SUBTITLE B—INTERIM STORAGE PROGRAM

FINDINGS AND PURPOSES

SEC. 131. (a) FINDINGS.—The Congress finds that— 42 USC 10151

(1) the persons owning and operating civilian nuclear power reactors have the primary responsibility for providing interim storage of spent nuclear fuel from such reactors, by maximizing, to the extent practical, the effective use of existing storage facilities at the site of each civilian nuclear power reactor, and by adding new onsite storage capacity in a timely manner where practical;

(2) the Federal Government has the responsibility to encourage and expedite the effective use of existing storage facilities and the addition of needed new storage capacity at the site of each civilian nuclear power reactor; and

(3) the Federal Government has the responsibility to provide, in accordance with the provisions of this subtitle, not more than 1,900 metric tons of capacity for interim storage of spent nuclear fuel for civilian nuclear power reactors that cannot reasonably provide adequate storage capacity at the sites of such

reactors when needed to assure the continued, orderly operation of such reactors.

(b) PURPOSES.—The purposes of this subtitle are—

(1) to provide for the utilization of available spent nuclear fuel pools at the site of each civilian nuclear power reactor to the extent practical and the addition of new spent nuclear fuel storage capacity where practical at the site of such reactor; and

(2) to provide, in accordance with the provisions of this subtitle, for the establishment of a federally owned and operated system for the interim storage of spent nuclear fuel at one or more facilities owned by the Federal Government with not more than 1,900 metric tons of capacity to prevent disruptions in the orderly operation of any civilian nuclear power reactor that cannot reasonably provide adequate spent nuclear fuel storage capacity at the site of such reactor when needed.

AVAILABLE CAPACITY FOR INTERIM STORAGE OF SPENT NUCLEAR FUEL

42 USC 10152

SEC. 132. The Secretary, the Commission, and other authorized Federal officials shall each take such actions as such official considers necessary to encourage and expedite the effective use of available storage, and necessary additional storage, at the site of each civilian nuclear power reactor consistent with—

(1) the protection of the public health and safety, and the environment;

(2) economic considerations;

(3) continued operation of such reactor;

(4) any applicable provisions of law; and

(5) the views of the population surrounding such reactor.

INTERIM AT REACTOR STORAGE

Licensing procedures.
42 USC 10153

SEC. 133. The Commission shall, by rule, establish procedures for the licensing of any technology approved by the Commission under section 219(a) for use at the site of any civilian nuclear power reactor. The establishment of such procedures shall not preclude the licensing, under any applicable procedures or rules of the Commission in effect prior to such establishment, of any technology for the storage of civilian spent nuclear fuel at the site of any civilian nuclear power reactor.

LICENSING OF FACILITY EXPANSIONS AND TRANSSHIPMENTS

42 USC 10154.

SEC. 134. (a) ORAL ARGUMENT.—In any Commission hearing under section 189 of the Atomic Energy Act of 1954 (42 U.S.C. 2239) on an application for a license, or for an amendment to an existing license, filed after the date of the enactment of this Act, to expand the spent nuclear fuel storage capacity at the site of a civilian nuclear power reactor, through the use of high-density fuel storage racks, fuel rod compaction, the transshipment of spent nuclear fuel to another civilian nuclear power reactor within the same utility system, the construction of additional spent nuclear fuel pool capacity or dry storage capacity, or by other means, the Commission shall, at the request of any party, provide an opportunity for oral argument with respect to any matter which the Commission determines to be in controversy among the parties. The oral argument shall be preceded by such discovery procedures as the rules of the Commission shall

provide. The Commission shall require each party, including the Commission staff, to submit in written form, at the time of the oral argument, a summary of the facts, data, and arguments upon which such party proposes to rely that are known at such time to such party. Only facts and data in the form of sworn testimony or written submission may be relied upon by the parties during oral argument. Of the materials that may be submitted by the parties during oral argument, the Commission shall only consider those facts and data that are submitted in the form of sworn testimony or written submission.

Summary submittal of facts, data and arguments.

(b) ADJUDICATORY HEARING.—(1) At the conclusion of any oral argument under subsection (a), the Commission shall designate any disputed question of fact, together with any remaining questions of law, for resolution in an adjudicatory hearing only if it determines that—

(A) there is a genuine and substantial dispute of fact which can only be resolved with sufficient accuracy by the introduction of evidence in an adjudicatory hearing; and

(B) the decision of the Commission is likely to depend in whole or in part on the resolution of such dispute.

(2) In making a determination under this subsection, the Commission—

(A) shall designate in writing the specific facts that are in genuine and substantial dispute, the reason why the decision of the agency is likely to depend on the resolution of such facts, and the reason why an adjudicatory hearing is likely to resolve the dispute; and

(B) shall not consider—

(i) any issue relating to the design, construction, or operation of any civilian nuclear power reactor already licensed to operate at such site, or any civilian nuclear power reactor for which a construction permit has been granted at such site, unless the Commission determines that any such issue substantially affects the design, construction, or operation of the facility or activity for which such license application, authorization, or amendment is being considered; or

(ii) any siting or design issue fully considered and decided by the Commission in connection with the issuance of a construction permit or operating license for a civilian nuclear power reactor at such site, unless (I) such issue results from any revision of siting or design criteria by the Commission following such decision; and (II) the Commission determines that such issue substantially affects the design, construction, or operation of the facility or activity for which such license application, authorization, or amendment is being considered.

(3) The provisions of paragraph (2)(B) shall apply only with respect to licenses, authorizations, or amendments to licenses or authorizations, applied for under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) before December 31, 2005.

(4) The provisions of this section shall not apply to the first application for a license or license amendment received by the Commission to expand onsite spent fuel storage capacity by the use of a new technology not previously approved for use at any nuclear powerplant by the Commission.

(c) JUDICIAL REVIEW.—No court shall hold unlawful or set aside a decision of the Commission in any proceeding described in subsection (a) because of a failure by the Commission to use a particular procedure pursuant to this section unless—

(1) an objection to the procedure used was presented to the Commission in a timely fashion or there are extraordinary circumstances that excuse the failure to present a timely objection; and

(2) the court finds that such failure has precluded a fair consideration and informed resolution of a significant issue of the proceeding taken as a whole.

STORAGE OF SPENT NUCLEAR FUEL

Ante, p. 2205.
42 USC 10155.

SEC. 135. (a) STORAGE CAPACITY.—(1) Subject to section 8, the Secretary shall provide, in accordance with paragraph (5), not more than 1,900 metric tons of capacity for the storage of spent nuclear fuel from civilian nuclear power reactors. Such storage capacity shall be provided through any one or more of the following methods, used in any combination determined by the Secretary to be appropriate:

(A) use of available capacity at one or more facilities owned by the Federal Government on the date of the enactment of this Act, including the modification and expansion of any such facilities, if the Commission determines that such use will adequately protect the public health and safety, except that such use shall not—

(i) render such facilities subject to licensing under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) or the Energy Reorganization Act of 1974 (42 U.S.C. 5801 et seq.); or

(ii) except as provided in subsection (c) require the preparation of an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)), such facility is already being used, or has previously been used, for such storage or for any similar purpose.

(B) acquisition of any modular or mobile spent nuclear fuel storage equipment, including spent nuclear fuel storage casks, and provision of such equipment, to any person generating or holding title to spent nuclear fuel, at the site of any civilian nuclear power reactor operated by such person or at any site owned by the Federal Government on the date of enactment of this Act;

(C) construction of storage capacity at any site of a civilian nuclear power reactor.

(2) Storage capacity authorized by paragraph (1) shall not be provided at any Federal or non-Federal site within which there is a candidate site for a repository. The restriction in the preceding sentence shall only apply until such time as the Secretary decides that such candidate site is no longer a candidate site under consideration for development as a repository.

(3) In selecting methods of providing storage capacity under paragraph (1), the Secretary shall consider the timeliness of the availability of each such method and shall seek to minimize the transportation of spent nuclear fuel, the public health and safety impacts, and the costs of providing such storage capacity.

(4) In providing storage capacity through any method described in paragraph (1), the Secretary shall comply with any applicable requirements for licensing or authorization of such method, except as provided in paragraph (1)(A)(i).

(5) The Secretary shall ensure that storage capacity is made available under paragraph (1) when needed, as determined on the basis of the storage needs specified in contracts entered into under section 136(a), and shall accept upon request any spent nuclear fuel as covered under such contracts.

(6) For purposes of paragraph (1)(A), the term "facility" means any building or structure. "Facility."

(b) CONTRACTS.—(1) Subject to the capacity limitation established in subsections (a)(1) and (d), the Secretary shall offer to enter into, and may enter into, contracts under section 136(a) with any person generating or owning spent nuclear fuel for purposes of providing storage capacity for such spent fuel under this section only if the Commission determines that—

(A) adequate storage capacity to ensure the continued orderly operation of the civilian nuclear power reactor at which such spent nuclear fuel is generated cannot reasonably be provided by the person owning and operating such reactor at such site, or at the site of any other civilian nuclear power reactor operated by such person, and such capacity cannot be made available in a timely manner through any method described in subparagraph (B); and

(B) such person is diligently pursuing licensed alternatives to the use of Federal storage capacity for the storage of spent nuclear fuel expected to be generated by such person in the future, including—

(i) expansion of storage facilities at the site of any civilian nuclear power reactor operated by such person;

(ii) construction of new or additional storage facilities at the site of any civilian nuclear power reactor operated by such person;

(iii) acquisition of modular or mobile spent nuclear fuel storage equipment, including spent nuclear fuel storage casks, for use at the site of any civilian nuclear power reactor operated by such person; and

(iv) transshipment to another civilian nuclear power reactor owned by such person.

(2) In making the determination described in paragraph (1)(A), the Commission shall ensure maintenance of a full core reserve storage capability at the site of the civilian nuclear power reactor involved unless the Commission determines that maintenance of such capability is not necessary for the continued orderly operation of such reactor.

(3) The Commission shall complete the determinations required in paragraph (1) with respect to any request for storage capacity not later than 6 months after receipt of such request by the Commission.

(c) ENVIRONMENTAL REVIEW.—(1) The provision of 300 or more metric tons of storage capacity at any one Federal site under subsection (a)(1)(A) shall be considered to be a major Federal action requiring preparation of an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)).

(2)(A) The Secretary shall prepare, and make available to the public, an environmental assessment of the probable impacts of any Public availability

provision of less than 300 metric tons of storage capacity at any one Federal site under subsection (a)(1)(A) that requires the modification or expansion of any facility at the site, and a discussion of alternative activities that may be undertaken to avoid such impacts. Such environmental assessment shall include—

Environmental assessment.

(i) an estimate of the amount of storage capacity to be made available at such site;

(ii) an evaluation as to whether the facilities to be used at such site are suitable for the provision of such storage capacity;

(iii) a description of activities planned by the Secretary with respect to the modification or expansion of the facilities to be used at such site;

(iv) an evaluation of the effects of the provision of such storage capacity at such site on the public health and safety, and the environment;

(v) a reasonable comparative evaluation of current information with respect to such site and facilities and other sites and facilities available for the provision of such storage capacity;

(vi) a description of any other sites and facilities that have been considered by the Secretary for the provision of such storage capacity; and

(vii) an assessment of the regional and local impacts of providing such storage capacity at such site, including the impacts on transportation.

Judicial review.

(B) The issuance of any environmental assessment under this paragraph shall be considered to be a final agency action subject to judicial review in accordance with the provisions of chapter 7 of title 5, United States Code. Such judicial review shall be limited to the sufficiency of such assessment with respect to the items described in clauses (i) through (vii) of subparagraph (A).

5 USC 701 *et seq.*

(3) Judicial review of any environmental impact statement or environmental assessment prepared pursuant to this subsection shall be conducted in accordance with the provisions of section 119.

(d) REVIEW OF SITES AND STATE PARTICIPATION.—(1) In carrying out the provisions of this subtitle with regard to any interim storage of spent fuel from civilian nuclear power reactors which the Secretary is authorized by section 135 to provide, the Secretary shall, as soon as practicable, notify, in writing, the Governor and the State legislature of any State and the Tribal Council of any affected Indian tribe in such State in which is located a potentially acceptable site or facility for such interim storage of spent fuel of his intention to investigate that site or facility.

Investigation.

(2) During the course of investigation of such site or facility, the Secretary shall keep the Governor, State legislature, and affected Tribal Council currently informed of the progress of the work, and results of the investigation. At the time of selection by the Secretary of any site or existing facility, but prior to undertaking any site-specific work or alterations, the Secretary shall promptly notify the Governor, the legislature, and any affected Tribal Council in writing of such selection, and subject to the provisions of paragraph (6) of this subsection, shall promptly enter into negotiations with such State and affected Tribal Council to establish a cooperative agreement under which such State and Council shall have the right to participate in a process of consultation and cooperation, based on public health and safety and environmental concerns, in all stages of the planning, development, modification, expansion, operation, and closure of storage capacity at a site or facility within such State

for the interim storage of spent fuel from civilian nuclear power reactors. Public participation in the negotiation of such an agreement shall be provided for and encouraged by the Secretary, the State, and the affected Tribal Council. The Secretary, in cooperation with the States and Indian tribes, shall develop and publish minimum guidelines for public participation in such negotiations, but the adequacy of such guidelines or any failure to comply with such guidelines shall not be a basis for judicial review.

Guidelines

(3) The cooperative agreement shall include, but need not be limited to, the sharing in accordance with applicable law of all technical and licensing information, the utilization of available expertise, the facilitating of permitting procedures, joint project review, and the formulation of joint surveillance and monitoring arrangements to carry out applicable Federal and State laws. The cooperative agreement also shall include a detailed plan or schedule of milestones, decision points and opportunities for State or eligible Tribal Council review and objection. Such cooperative agreement shall provide procedures for negotiating and resolving objections of the State and affected Tribal Council in any stage of planning, development, modification, expansion, operation, or closure of storage capacity at a site or facility within such State. The terms of any cooperative agreement shall not affect the authority of the Nuclear Regulatory Commission under existing law.

Cooperative agreement

(4) For the purpose of this subsection, "process of consultation and cooperation" means a methodology by which the Secretary (A) keeps the State and eligible Tribal Council fully and currently informed about the aspects of the project related to any potential impact on the public health and safety and environment; (B) solicits, receives, and evaluates concerns and objections of such State and Council with regard to such aspects of the project on an ongoing basis; and (C) works diligently and cooperatively to resolve, through arbitration or other appropriate mechanisms, such concerns and objections. The process of consultation and cooperation shall not include the grant of a right to any State or Tribal Council to exercise an absolute veto of any aspect of the planning, development, modification, expansion, or operation of the project.

"Process of consultation and cooperation"

(5) The Secretary and the State and affected Tribal Council shall seek to conclude the agreement required by paragraph (2) as soon as practicable, but not later than 180 days following the date of notification of the selection under paragraph (2). The Secretary shall periodically report to the Congress thereafter on the status of the agreements approved under paragraph (3). Any report to the Congress on the status of negotiations of such agreement by the Secretary shall be accompanied by comments solicited by the Secretary from the State and eligible Tribal Council.

Report to Congress.

(6)(A) Upon deciding to provide an aggregate of 300 or more metric tons of storage capacity under subsection (a)(1) at any one site, the Secretary shall notify the Governor and legislature of the State where such site is located, or the governing body of the Indian tribe in whose reservation such site is located, as the case may be, of such decision. During the 60-day period following receipt of notification by the Secretary of his decision to provide an aggregate of 300 or more metric tons of storage capacity at any one site, the Governor or legislature of the State in which such site is located, or the governing body of the affected Indian tribe where such site is located, as the case may be, may disapprove the provision of 300 or more metric tons of storage capacity at the site involved and submit to the

Notice of disapproval, submittal to Congress.

Congress a notice of such disapproval. A notice of disapproval shall be considered to be submitted to the Congress on the date of the transmittal of such notice of disapproval to the Speaker of the House and the President pro tempore of the Senate. Such notice of disapproval shall be accompanied by a statement of reasons explaining why the provision of such storage capacity at such site was disapproved by such Governor or legislature or the governing body of such Indian tribe.

(B) Unless otherwise provided by State law, the Governor or legislature of each State shall have authority to submit a notice of disapproval to the Congress under subparagraph (A). In any case in which State law provides for submission of any such notice of disapproval by any other person or entity, any reference in this subtitle to the Governor or legislature of such State shall be considered to refer instead to such other person or entity.

(C) The authority of the Governor and legislature of each State under this paragraph shall not be applicable with respect to any site located on a reservation.

(D) If any notice of disapproval is submitted to the Congress under subparagraph (A), the proposed provision of 300 or more metric tons of storage capacity at the site involved shall be disapproved unless, during the first period of 90 calendar days of continuous session of the Congress following the date of the receipt by the Congress of such notice of disapproval, the Congress passes a resolution approving such proposed provision of storage capacity in accordance with the procedures established in this paragraph and subsections (d) through (f) of section 115 and such resolution thereafter becomes law. For purposes of this paragraph, the term "resolution" means a joint resolution of either House of the Congress, the matter after the resolving clause of which is as follows: "That there hereby is approved the provision of 300 or more metric tons of spent nuclear fuel storage capacity at the site located at _____, with respect to which a notice of disapproval was submitted by _____ on _____.". The first blank space in such resolution shall be filled with the geographic location of the site involved; the second blank space in such resolution shall be filled with the designation of the State Governor and legislature or affected Indian tribe governing body submitting the notice of disapproval involved; and the last blank space in such resolution shall be filled with the date of submission of such notice of disapproval.

Ante, p. 2217.

"Resolution."

(E) For purposes of the consideration of any resolution described in subparagraph (D), each reference in subsections (d) and (e) of section 115 to a resolution of repository siting approval shall be considered to refer to the resolution described in such subparagraph.

"Affected Tribal Council."

(7) As used in this section, the term "affected Tribal Council" means the governing body of any Indian tribe within whose reservation boundaries there is located a potentially acceptable site for interim storage capacity of spent nuclear fuel from civilian nuclear power reactors, or within whose boundaries a site for such capacity is selected by the Secretary, or whose federally defined possessory or usage rights to other lands outside of the reservation's boundaries arising out of congressionally ratified treaties, as determined by the Secretary of the Interior pursuant to a petition filed with him by the appropriate governmental officials of such tribe, may be substantially and adversely affected by the establishment of any such storage capacity.

(e) LIMITATIONS.—Any spent nuclear fuel stored under this section shall be removed from the storage site or facility involved as soon as practicable, but in any event not later than 3 years following the date on which a repository or monitored retrievable storage facility developed under this Act is available for disposal of such spent nuclear fuel.

(f) REPORT.—The Secretary shall annually prepare and submit to the Congress a report on any plans of the Secretary for providing storage capacity under this section. Such report shall include a description of the specific manner of providing such storage selected by the Secretary, if any. The Secretary shall prepare and submit the first such report not later than 1 year after the date of the enactment of this Act.

(g) CRITERIA FOR DETERMINING ADEQUACY OF AVAILABLE STORAGE CAPACITY.—Not later than 90 days after the date of the enactment of this Act, the Commission pursuant to section 553 of the Administrative Procedures Act, shall propose, by rule, procedures and criteria for making the determination required by subsection (b) that a person owning and operating a civilian nuclear power reactor cannot reasonably provide adequate spent nuclear fuel storage capacity at the civilian nuclear power reactor site when needed to ensure the continued orderly operation of such reactor. Such criteria shall ensure the maintenance of a full core reserve storage capability at the site of such reactor unless the Commission determines that maintenance of such capability is not necessary for the continued orderly operation of such reactor. Such criteria shall identify the feasibility of reasonably providing such adequate spent nuclear fuel storage capacity, taking into account economic, technical, regulatory, and public health and safety factors, through the use of high-density fuel storage racks, fuel rod compaction, transshipment of spent nuclear fuel to another civilian nuclear power reactor within the same utility system, construction of additional spent nuclear fuel pool capacity, or such other technologies as may be approved by the Commission. 5 USC 553.

(h) APPLICATION.—Notwithstanding any other provision of law, nothing in this Act shall be construed to encourage, authorize, or require the private or Federal use, purchase, lease, or other acquisition of any storage facility located away from the site of any civilian nuclear power reactor and not owned by the Federal Government on the date of the enactment of this Act.

(i) COORDINATION WITH RESEARCH AND DEVELOPMENT PROGRAM.—To the extent available, and consistent with the provisions of this section, the Secretary shall provide spent nuclear fuel for the research and development program authorized in section 217 from spent nuclear fuel received by the Secretary for storage under this section. Such spent nuclear fuel shall not be subject to the provisions of subsection (e).

INTERIM STORAGE FUND

SEC. 136. (a) CONTRACTS.—(1) During the period following the date of the enactment of this Act, but not later than January 1, 1990, the Secretary is authorized to enter into contracts with persons who generate or own spent nuclear fuel resulting from civilian nuclear activities for the storage of such spent nuclear fuel in any storage capacity provided under this subtitle: *Provided, however,* That the Secretary shall not enter into contracts for spent nuclear fuel in 42 USC 10156.

amounts in excess of the available storage capacity specified in section 135(a). Those contracts shall provide that the Federal Government will (1) take title at the civilian nuclear power reactor site, to such amounts of spent nuclear fuel from the civilian nuclear power reactor as the Commission determines cannot be stored onsite, (2) transport the spent nuclear fuel to a federally owned and operated interim away-from-reactor storage facility, and (3) store such fuel in the facility pending further processing, storage, or disposal. Each such contract shall (A) provide for payment to the Secretary of fees determined in accordance with the provisions of this section; and (B) specify the amount of storage capacity to be provided for the person involved.

Study; report to Congress.

(2) The Secretary shall undertake a study and, not later than 180 days after the date of the enactment of this Act, submit to the Congress a report, establishing payment charges that shall be calculated on an annual basis, commencing on or before January 1, 1984.

Publication in Federal Register

Such payment charges and the calculation thereof shall be published in the Federal Register, and shall become effective not less than 30 days after publication. Each payment charge published in the Federal Register under this paragraph shall remain effective for a period of 12 months from the effective date as the charge for the cost of the interim storage of any spent nuclear fuel. The report of the Secretary shall specify the method and manner of collection (including the rates and manner of payment) and any legislative recommendations determined by the Secretary to be appropriate.

Fees.

(3) Fees for storage under this subtitle shall be established on a nondiscriminatory basis. The fees to be paid by each person entering into a contract with the Secretary under this subsection shall be based upon an estimate of the pro rata costs of storage and related activities under this subtitle with respect to such person, including the acquisition, construction, operation, and maintenance of any facilities under this subtitle.

(4) The Secretary shall establish in writing criteria setting forth the terms and conditions under which such storage services shall be made available.

(5) Except as provided in section 137, nothing in this or any other Act requires the Secretary, in carrying out the responsibilities of this section, to obtain a license or permit to possess or own spent nuclear fuel.

(b) LIMITATION.—No spent nuclear fuel generated or owned by any department of the United States referred to in section 101 or 102 of title 5, United States Code, may be stored by the Secretary in any storage capacity provided under this subtitle unless such department transfers to the Secretary, for deposit in the Interim Storage Fund, amounts equivalent to the fees that would be paid to the Secretary under the contracts referred to in this section if such spent nuclear fuel were generated by any other person.

(c) ESTABLISHMENT OF INTERIM STORAGE FUND.—There hereby is established in the Treasury of the United States a separate fund, to be known as the Interim Storage Fund. The Storage Fund shall consist of—

(1) all receipts, proceeds, and recoveries realized by the Secretary under subsections (a), (b), and (e), which shall be deposited in the Storage Fund immediately upon their realization;

(2) any appropriations made by the Congress to the Storage Fund; and

(3) any unexpended balances available on the date of the enactment of this Act for functions or activities necessary or incident to the interim storage of civilian spent nuclear fuel, which shall automatically be transferred to the Storage Fund on such date.

(d) USE OF STORAGE FUND.—The Secretary may make expenditures from the Storage Fund, subject to subsection (e), for any purpose necessary or appropriate to the conduct of the functions and activities of the Secretary, or the provision or anticipated provision of services, under this subtitle, including—

(1) the identification, development, licensing, construction, operation, decommissioning, and post-decommissioning maintenance and monitoring of any interim storage facility provided under this subtitle;

(2) the administrative cost of the interim storage program;

(3) the costs associated with acquisition, design, modification, replacement, operation, and construction of facilities at an interim storage site, consistent with the restrictions in section 135;

(4) the cost of transportation of spent nuclear fuel; and

(5) impact assistance as described in subsection (e).

(e) IMPACT ASSISTANCE.—(1) Beginning the first fiscal year which commences after the date of the enactment of this Act, the Secretary shall make annual impact assistance payments to a State or appropriate unit of local government, or both, in order to mitigate social or economic impacts occasioned by the establishment and subsequent operation of any interim storage capacity within the jurisdictional boundaries of such government or governments and authorized under this subtitle: *Provided, however,* That such impact assistance payments shall not exceed (A) ten per centum of the costs incurred in paragraphs (1) and (2), or (B) $15 per kilogram of spent fuel, whichever is less; Payments.

(2) Payments made available to States and units of local government pursuant to this section shall be—

(A) allocated in a fair and equitable manner with a priority to those States or units of local government suffering the most severe impacts; and

(B) utilized by States or units of local governments only for (i) planning, (ii) construction and maintenance of public services, (iii) provision of public services related to the providing of such interim storage authorized under this title, and (iv) compensation for loss of taxable property equivalent to that if the storage had been provided under private ownership.

(3) Such payments shall be subject to such terms and conditions as the Secretary determines necessary to ensure that the purposes of this subsection shall be achieved. The Secretary shall issue such regulations as may be necessary to carry out the provisions of this subsection. Regulations.

(4) Payments under this subsection shall be made available solely from the fees determined under subsection (a).

(5) The Secretary is authorized to consult with States and appropriate units of local government in advance of commencement of establishment of storage capacity authorized under this subtitle in an effort to determine the level of the payment such government would be eligible to receive pursuant to this subsection.

(6) As used in this subsection, the term "unit of local government" means a county, parish, township, municipality, and shall include a "Unit of local government."

borough existing in the State of Alaska on the date of the enactment of this subsection, and any other unit of government below the State level which is a unit of general government as determined by the Secretary.

Report to Congress.

(f) ADMINISTRATION OF STORAGE FUND.—(1) The Secretary of the Treasury shall hold the Storage Fund and, after consultation with the Secretary, annually report to the Congress on the financial condition and operations of the Storage Fund during the preceding fiscal year.

Budget submittal.

(2) The Secretary shall submit the budget of the Storage Fund to the Office of Management and Budget triennially along with the budget of the Department of Energy submitted at such time in accordance with chapter 11 of title 31, United States Code. The budget of the Storage Fund shall consist of estimates made by the Secretary of expenditures from the Storage Fund and other relevant financial matters for the succeeding 3 fiscal years, and shall be included in the Budget of the United States Government. The Secretary may make expenditures from the Storage Fund, subject to appropriations which shall remain available until expended. Appropriations shall be subject to triennial authorization.

Ante, p. 907.

(3) If the Secretary determines that the Storage Fund contains at any time amounts in excess of current needs, the Secretary may request the Secretary of the Treasury to invest such amounts, or any portion of such amounts as the Secretary determines to be appropriate, in obligations of the United States—

(A) having maturities determined by the Secretary of the Treasury to be appropriate to the needs of the Storage Fund; and

(B) bearing interest at rates determined to be appropriate by the Secretary of the Treasury, taking into consideration the current average market yield on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the maturities of such investments, except that the interest rate on such investments shall not exceed the average interest rate applicable to existing borrowings.

(4) Receipts, proceeds, and recoveries realized by the Secretary under this section, and expenditures of amounts from the Storage Fund, shall be exempt from annual apportionment under the provisions of subchapter II of chapter 15 of title 31, United States Code.

Ante, p. 927.

(5) If at any time the moneys available in the Storage Fund are insufficient to enable the Secretary to discharge his responsibilities under this subtitle, the Secretary shall issue to the Secretary of the Treasury obligations in such forms and denominations, bearing such maturities, and subject to such terms and conditions as may be agreed to by the Secretary and the Secretary of the Treasury. The total of such obligations shall not exceed amounts provided in appropriation Acts. Redemption of such obligations shall be made by the Secretary from moneys available in the Storage Fund. Such obligations shall bear interest at a rate determined by the Secretary of the Treasury, which shall be not less than a rate determined by taking into consideration the average market yield on outstanding marketable obligations of the United States of comparable maturities during the month preceding the issuance of the obligations under this paragraph. The Secretary of the Treasury shall purchase any issued obligations, and for such purpose the Secretary of the Treasury is authorized to use as a public debt transaction the proceeds from the sale of any securities issued under chapter 31 of

title 31, United States Code, and the purposes for which securities may be issued under such Act are extended to include any purchase of such obligations. The Secretary of the Treasury may at any time sell any of the obligations acquired by him under this paragraph. All redemptions, purchases, and sales by the Secretary of the Treasury of obligations under this paragraph shall be treated as public debt transactions of the United States. *Ante*, p. 937.

(6) Any appropriations made available to the Storage Fund for any purpose described in subsection (d) shall be repaid into the general fund of the Treasury, together with interest from the date of availability of the appropriations until the date of repayment. Such interest shall be paid on the cumulative amount of appropriations available to the Storage Fund, less the average undisbursed cash balance in the Storage Fund account during the fiscal year involved. The rate of such interest shall be determined by the Secretary of the Treasury taking into consideration the average market yield during the month preceding each fiscal year on outstanding marketable obligations of the United States of comparable maturity. Interest payments may be deferred with the approval of the Secretary of the Treasury, but any interest payments so deferred shall themselves bear interest. Interest payments. Deferral.

SEC. 137. (a) TRANSPORTATION.—(1) Transportation of spent nuclear fuel under section 136(a) shall be subject to licensing and regulation by the Commission and by the Secretary of Transportation as provided for transportation of commercial spent nuclear fuel under existing law. 42 USC 10157.

(2) The Secretary, in providing for the transportation of spent nuclear fuel under this Act, shall utilize by contract private industry to the fullest extent possible in each aspect of such transportation. The Secretary shall use direct Federal services for such transportation only upon a determination of the Secretary of Transportation, in consultation with the Secretary, that private industry is unable or unwilling to provide such transportation services at reasonable cost.

SUBTITLE C—MONITORED RETRIEVABLE STORAGE

MONITORED RETRIEVABLE STORAGE

SEC. 141. (a) FINDINGS.—The Congress finds that— 42 USC 10161

(1) long-term storage of high-level radioactive waste or spent nuclear fuel in monitored retrievable storage facilities is an option for providing safe and reliable management of such waste or spent fuel;

(2) the executive branch and the Congress should proceed as expeditiously as possible to consider fully a proposal for construction of one or more monitored retrievable storage facilities to provide such long-term storage;

(3) the Federal Government has the responsibility to ensure that site-specific designs for such facilities are available as provided in this section;

(4) the generators and owners of the high-level radioactive waste and spent nuclear fuel to be stored in such facilities have the responsibility to pay the costs of the long-term storage of such waste and spent fuel; and

(5) disposal of high-level radioactive waste and spent nuclear fuel in a repository developed under this Act should proceed

regardless of any construction of a monitored retrievable storage facility pursuant to this section.

(b) SUBMISSION OF PROPOSAL BY SECRETARY.—(1) On or before June 1, 1985, the Secretary shall complete a detailed study of the need for and feasibility of, and shall submit to the Congress a proposal for, the construction of one or more monitored retrievable storage facilities for high-level radioactive waste and spent nuclear fuel. Each such facility shall be designed—

(A) to accommodate spent nuclear fuel and high-level radioactive waste resulting from civilian nuclear activities;

(B) to permit continuous monitoring, management, and maintenance of such spent fuel and waste for the foreseeable future;

(C) to provide for the ready retrieval of such spent fuel and waste for further processing or disposal; and

(D) to safely store such spent fuel and waste as long as may be necessary by maintaining such facility through appropriate means, including any required replacement of such facility.

(2) Such proposal shall include—

(A) the establishment of a Federal program for the siting, development, construction, and operation of facilities capable of safely storing high-level radioactive waste and spent nuclear fuel, which facilities are to be licensed by the Commission;

(B) a plan for the funding of the construction and operation of such facilities, which plan shall provide that the costs of such activities shall be borne by the generators and owners of the high-level radioactive waste and spent nuclear fuel to be stored in such facilities;

(C) site-specific designs, specifications, and cost estimates sufficient to (i) solicit bids for the construction of the first such facility; (ii) support congressional authorization of the construction of such facility; and (iii) enable completion and operation of such facility as soon as practicable following congressional authorization of such facility; and

(D) a plan for integrating facilities constructed pursuant to this section with other storage and disposal facilities authorized in this Act.

Consultations.

(3) In formulating such proposal, the Secretary shall consult with the Commission and the Administrator, and shall submit their comments on such proposal to the Congress at the time such proposal is submitted.

(4) The proposal shall include, for the first such facility, at least 3 alternative sites and at least 5 alternative combinations of such proposed sites and facility designs consistent with the criteria of paragraph (b)(1). The Secretary shall recommend the combination among the alternatives that the Secretary deems preferable. The environmental assessment under subsection (c) shall include a full analysis of the relative advantages and disadvantages of all 5 such alternative combinations of proposed sites and proposed facility designs.

(c) ENVIRONMENTAL IMPACT STATEMENTS.—(1) Preparation and submission to the Congress of the proposal required in this section shall not require the preparation of an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)). The Secretary shall prepare, in accordance with regulations issued by the Secretary implementing such Act, an environmental assessment with respect to such proposal. Such environmental assessment shall be based upon available

Environmental assessment.

information regarding alternative technologies for the storage of spent nuclear fuel and high-level radioactive waste. The Secretary shall submit such environmental assessment to the Congress at the time such proposal is submitted. Submittal to Congress.

(2) If the Congress by law, after review of the proposal submitted by the Secretary under subsection (b), specifically authorizes construction of a monitored retrievable storage facility, the requirements of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) shall apply with respect to construction of such facility, except that any environmental impact statement prepared with respect to such facility shall not be required to consider the need for such facility or any alternative to the design criteria for such facility set forth in subsection (b)(1).

(d) LICENSING.—Any facility authorized pursuant to this section shall be subject to licensing under section 202(3) of the Energy Reorganization Act of 1974 (42 U.S.C. 5842(3)). In reviewing the application filed by the Secretary for licensing of the first such facility, the Commission may not consider the need for such facility or any alternative to the design criteria for such facility set forth in subsection (b)(1).

(e) CLARIFICATION.—Nothing in this section limits the consideration of alternative facility designs consistent with the criteria of paragraph (b)(1) in any environmental impact statement, or in any licensing procedure of the Commission, with respect to any monitored, retrievable facility authorized pursuant to this section.

(f) IMPACT ASSISTANCE.—(1) Upon receipt by the Secretary of congressional authorization to construct a facility described in subsection (b), the Secretary shall commence making annual impact aid payments to appropriate units of general local government in order to mitigate any social or economic impacts resulting from the construction and subsequent operation of any such facility within the jurisdictional boundaries of any such unit. Payments.

(2) Payments made available to units of general local government under this subsection shall be—

(A) allocated in a fair and equitable manner, with priority given to units of general local government determined by the Secretary to be most severely affected; and

(B) utilized by units of general local government only for planning, construction, maintenance, and provision of public services related to the siting of such facility.

(3) Such payments shall be subject to such terms and conditions as the Secretary determines are necessary to ensure achievement of the purposes of this subsection. The Secretary shall issue such regulations as may be necessary to carry out the provisions of this subsection. Regulations.

(4) Such payments shall be made available entirely from funds held in the Nuclear Waste Fund established in section 302(c) and shall be available only to the extent provided in advance in appropriation Acts.

(5) The Secretary may consult with appropriate units of general local government in advance of commencement of construction of any such facility in an effort to determine the level of payments each such unit is eligible to receive under this subsection. Consultations.

(g) LIMITATION.—No monitored retrievable storage facility developed pursuant to this section may be constructed in any State in which there is located any site approved for site characterization under section 112. The restriction in the preceding sentence shall

Ante, p. 2208

only apply until such time as the Secretary decides that such candidate site is no longer a candidate site under consideration for development as a repository. Such restriction shall continue to apply to any site selected for construction as a repository.

(h) PARTICIPATION OF STATES AND INDIAN TRIBES.—Any facility authorized pursuant to this section shall be subject to the provisions of sections 115, 116(a), 116(b), 116(d), 117, and 118. For purposes of carrying out the provisions of this subsection, any reference in sections 115 through 118 to a repository shall be considered to refer to a monitored retrievable storage facility.

Ante, pp. 2217, 2220, 2222, 2225.

SUBTITLE D—LOW-LEVEL RADIOACTIVE WASTE

FINANCIAL ARRANGEMENTS FOR LOW-LEVEL RADIOACTIVE WASTE SITE CLOSURE

42 USC 10171.

SEC. 151. (a) FINANCIAL ARRANGEMENTS.—(1) The Commission shall establish by rule, regulation, or order, after public notice, and in accordance with section 181 of the Atomic Energy Act of 1954 (42 U.S.C. 2231), such standards and instructions as the Commission may deem necessary or desirable to ensure in the case of each license for the disposal of low-level radioactive waste that an adequate bond, surety, or other financial arrangement (as determined by the Commission) will be provided by a licensee to permit completion of all requirements established by the Commission for the decontamination, decommissioning, site closure, and reclamation of sites, structures, and equipment used in conjunction with such low-level radioactive waste. Such financial arrangements shall be provided and approved by the Commission, or, in the case of sites within the boundaries of any agreement State under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021), by the appropriate State or State entity, prior to issuance of licenses for low-level radioactive waste disposal or, in the case of licenses in effect on the date of the enactment of this Act, prior to termination of such licenses.

(2) If the Commission determines that any long-term maintenance or monitoring, or both, will be necessary at a site described in paragraph (1), the Commission shall ensure before termination of the license involved that the licensee has made available such bonding, surety, or other financial arrangements as may be necessary to ensure that any necessary long-term maintenance or monitoring needed for such site will be carried out by the person having title and custody for such site following license termination.

(b) TITLE AND CUSTODY.—(1) The Secretary shall have authority to assume title and custody of low-level radioactive waste and the land on which such waste is disposed of, upon request of the owner of such waste and land and following termination of the license issued by the Commission for such disposal, if the Commission determines that—

(A) the requirements of the Commission for site closure, decommissioning, and decontamination have been met by the licensee involved and that such licensee is in compliance with the provisions of subsection (a);

(B) such title and custody will be transferred to the Secretary without cost to the Federal Government; and

(C) Federal ownership and management of such site is necessary or desirable in order to protect the public health and safety, and the environment.

(2) If the Secretary assumes title and custody of any such waste and land under this subsection, the Secretary shall maintain such waste and land in a manner that will protect the public health and safety, and the environment.

(c) SPECIAL SITES.—If the low-level radioactive waste involved is the result of a licensed activity to recover zirconium, hafnium, and rare earths from source material, the Secretary, upon request of the owner of the site involved, shall assume title and custody of such waste and the land on which it is disposed when such site has been decontaminated and stabilized in accordance with the requirements established by the Commission and when such owner has made adequate financial arrangements approved by the Commission for the long-term maintenance and monitoring of such site.

TITLE II—RESEARCH, DEVELOPMENT, AND DEMONSTRATION REGARDING DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL

PURPOSE

SEC. 211. It is the purpose of this title— 42 USC 10191

(1) to provide direction to the Secretary with respect to the disposal of high-level radioactive waste and spent nuclear fuel;

(2) to authorize the Secretary, pursuant to this title—

(A) to provide for the construction, operation, and maintenance of a deep geologic test and evaluation facility; and

(B) to provide for a focused and integrated high-level radioactive waste and spent nuclear fuel research and development program, including the development of a test and evaluation facility to carry out research and provide an integrated demonstration of the technology for deep geologic disposal of high-level radioactive waste, and the development of the facilities to demonstrate dry storage of spent nuclear fuel; and

(3) to provide for an improved cooperative role between the Federal Government and States, affected Indian tribes, and units of general local government in the siting of a test and evaluation facility.

APPLICABILITY

SEC. 212. The provisions of this title are subject to section 8 and shall not apply to facilities that are used for the disposal of high-level radioactive waste, low-level radioactive waste, transuranic waste, or spent nuclear fuel resulting from atomic energy defense activities. *Ante*, p. 2205 42 USC 10192

IDENTIFICATION OF SITES

SEC. 213. (a) GUIDELINES.—Not later than 6 months after the date of the enactment of this Act and notwithstanding the failure of other agencies to promulgate standards pursuant to applicable law, the Secretary, in consultation with the Commission, the Director of the Geological Survey, the Administrator, the Council on Environ- 42 USC 10193

mental Quality, and such other Federal agencies as the Secretary considers appropriate, is authorized to issue, pursuant to section 553 of title 5, United States Code, general guidelines for the selection of a site for a test and evaluation facility. Under such guidelines the Secretary shall specify factors that qualify or disqualify a site for development as a test and evaluation facility, including factors pertaining to the location of valuable natural resources, hydrogeophysics, seismic activity, and atomic energy defense activities, proximity to water supplies, proximity to populations, the effect upon the rights of users of water, and proximity to components of the National Park System, the National Wildlife Refuge System, the National Wild and Scenic Rivers System, the National Wilderness Preservation System, or National Forest Lands. Such guidelines shall require the Secretary to consider the various geologic media in which the site for a test and evaluation facility may be located and, to the extent practicable, to identify sites in different geologic media. The Secretary shall use guidelines established under this subsection in considering and selecting sites under this title.

(b) SITE IDENTIFICATION BY THE SECRETARY.—(1) Not later than 1 year after the date of the enactment of this Act, and following promulgation of guidelines under subsection (a), the Secretary is authorized to identify 3 or more sites, at least 2 of which shall be in different geologic media in the continental United States, and at least 1 of which shall be in media other than salt. Subject to Commission requirements, the Secretary shall give preference to sites for the test and evaluation facility in media possessing geochemical characteristics that retard aqueous transport of radionuclides. In order to provide a greater possible protection of public health and safety as operating experience is gained at the test and evaluation facility, and with the exception of the primary areas under review by the Secretary on the date of the enactment of this Act for the location of a test and evaluation facility or repository, all sites identified under this subsection shall be more than 15 statute miles from towns having a population of greater than 1,000 persons as determined by the most recent census unless such sites contain high-level radioactive waste prior to identification under this title.

Environmental assessment

Each identification of a site shall be supported by an environmental assessment, which shall include a detailed statement of the basis for such identification and of the probable impacts of the siting research activities planned for such site, and a discussion of alternative activities relating to siting research that may be undertaken to avoid such impacts. Such environmental assessment shall include—

(A) an evaluation by the Secretary as to whether such site is suitable for siting research under the guidelines established under subsection (a);

(B) an evaluation by the Secretary of the effects of the siting research activities at such site on the public health and safety and the environment;

(C) a reasonable comparative evaluation by the Secretary of such site with other sites and locations that have been considered;

(D) a description of the decision process by which such site was recommended; and

(E) an assessment of the regional and local impacts of locating the proposed test and evaluation facility at such site.

(2) When the Secretary identifies a site, the Secretary shall as soon as possible notify the Governor of the State in which such site

is located, or the governing body of the affected Indian tribe where such site is located, of such identification and the basis of such identification. Additional sites for the location of the test and evaluation facility authorized in section 302(d) may be identified after such 1 year period, following the same procedure as if such sites had been identified within such period.

SITING RESEARCH AND RELATED ACTIVITIES

SEC. 214. (a) IN GENERAL.—Not later than 30 months after the date on which the Secretary completes the identification of sites under section 213, the Secretary is authorized to complete sufficient evaluation of 3 sites to select a site for expanded siting research activities and for other activities under section 218. The Secretary is authorized to conduct such preconstruction activities relative to such site selection for the test and evaluation facility as he deems appropriate. Additional sites for the location of the test and evaluation facility authorized in section 302(d) may be evaluated after such 30-month period, following the same procedures as if such sites were to be evaluated within such period. 42 USC 10194

(b) PUBLIC MEETINGS AND ENVIRONMENTAL ASSESSMENT.—Not later than 6 months after the date on which the Secretary completes the identification of sites under section 213, and before beginning siting research activities, the Secretary shall hold at least 1 public meeting in the vicinity of each site to inform the residents of the area of the activities to be conducted at such site and to receive their views.

(c) RESTRICTIONS.—Except as provided in section 218 with respect to a test and evaluation facility, in conducting siting research activities pursuant to subsection (a)—

(1) the Secretary shall use the minimum quantity of high-level radioactive waste or other radioactive materials, if any, necessary to achieve the test or research objectives;

(2) the Secretary shall ensure that any radioactive material used or placed on a site shall be fully retrievable; and

(3) upon termination of siting research activities at a site for any reason, the Secretary shall remove any radioactive material at or in the site as promptly as practicable.

(d) TITLE TO MATERIAL.—The Secretary may take title, in the name of the Federal Government, to the high-level radioactive waste, spent nuclear fuel, or other radioactive material emplaced in a test and evaluation facility. If the Secretary takes title to any such material, the Secretary shall enter into the appropriate financial arrangements described in subsection (a) or (b) of section 302 for the disposal of such material.

TEST AND EVALUATION FACILITY SITING REVIEW AND REPORTS

SEC. 215. (a) CONSULTATION AND COOPERATION.—The Governor of a State, or the governing body of an affected Indian tribe, notified of a site identification under section 213 shall have the right to participate in a process of consultation and cooperation as soon as the site involved has been identified pursuant to such section and throughout the life of the test and evaluation facility. For purposes of this section, the term "process of consultation and cooperation" means a methodology— 42 USC 10195

"Process of consultation and cooperation."

(1) by which the Secretary—

(A) keeps the Governor or governing body involved fully and currently informed about any potential economic or public health and safety impacts in all stages of the siting, development, construction, and operation of a test and evaluation facility;

(B) solicits, receives, and evaluates concerns and objections of such Governor or governing body with regard to such test and evaluation facility on an ongoing basis; and

(C) works diligently and cooperatively to resolve such concerns and objections; and

(2) by which the State or affected Indian tribe involved can exercise reasonable independent monitoring and testing of onsite activities related to all stages of the siting, development, construction and operation of the test and evaluation facility, except that any such monitoring and testing shall not unreasonably interfere with onsite activities.

(b) WRITTEN AGREEMENTS.—The Secretary shall enter into written agreements with the Governor of the State in which an identified site is located or with the governing body of any affected Indian tribe where an identified site is located in order to expedite the consultation and cooperation process. Any such written agreement shall specify—

(1) procedures by which such Governor or governing body may study, determine, comment on, and make recommendations with regard to the possible health, safety, and economic impacts of the test and evaluation facility;

(2) procedures by which the Secretary shall consider and respond to comments and recommendations made by such Governor or governing body, including the period in which the Secretary shall so respond;

(3) the documents the Department is to submit to such Governor or governing body, the timing for such submissions, the timing for such Governor or governing body to identify public health and safety concerns and the process to be followed to try to eliminate those concerns;

(4) procedures by which the Secretary and either such Governor or governing body may review or modify the agreement periodically; and

(5) procedures for public notification of the procedures specified under subparagraphs (A) through (D).

(c) LIMITATION.—Except as specifically provided in this section, nothing in this title is intended to grant any State or affected Indian tribe any authority with respect to the siting, development, or loading of the test and evaluation facility.

FEDERAL AGENCY ACTIONS

42 USC 10196.

SEC. 216. (a) COOPERATION AND COORDINATION.—Federal agencies shall assist the Secretary by cooperating and coordinating with the Secretary in the preparation of any necessary reports under this title and the mission plan under section 301.

(b) ENVIRONMENTAL REVIEW.—(1) No action of the Secretary or any other Federal agency required by this title or section 301 with respect to a test and evaluation facility to be taken prior to the initiation of onsite construction of a test and evaluation facility shall require the preparation of an environmental impact statement under section 102(2)(C) of the Environmental Policy Act of 1969 (42

U.S.C. 4332(2)(C)), or to require the preparation of environmental reports, except as otherwise specifically provided for in this title.

(2) The Secretary and the heads of all other Federal agencies shall, to the maximum extent possible, avoid duplication of efforts in the preparation of reports under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).

RESEARCH AND DEVELOPMENT ON DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE

SEC. 217. (a) PURPOSE.—Not later than 64 months after the date of the enactment of this Act, the Secretary is authorized to, to the extent practicable, begin at a site evaluated under section 214, as part of and as an extension of siting research activities of such site under such section, the mining and construction of a test and evaluation facility. Prior to the mining and construction of such facility, the Secretary shall prepare an environmental assessment. The purpose of such facility shall be— 42 USC 10197. Environmental assessment.

(1) to supplement and focus the repository site characterization process;

(2) to provide the conditions under which known technological components can be integrated to demonstrate a functioning repository-like system;

(3) to provide a means of identifying, evaluating, and resolving potential repository licensing issues that could not be resolved during the siting research program conducted under section 212;

(4) to validate, under actual conditions, the scientific models used in the design of a repository;

(5) to refine the design and engineering of repository components and systems and to confirm the predicted behavior of such components and systems;

(6) to supplement the siting data, the generic and specific geological characteristics developed under section 214 relating to isolating disposal materials in the physical environment of a repository;

(7) to evaluate the design concepts for packaging, handling, and emplacement of high-level radioactive waste and spent nuclear fuel at the design rate; and

(8) to establish operating capability without exposing workers to excessive radiation.

(b) DESIGN.—The Secretary shall design each test and evaluation facility—

(1) to be capable of receiving not more than 100 full-sized canisters of solidified high-level radioactive waste (which canisters shall not exceed an aggregate weight of 100 metric tons), except that spent nuclear fuel may be used instead of such waste if such waste cannot be obtained under reasonable conditions;

(2) to permit full retrieval of solidified high-level radioactive waste, or other radioactive material used by the Secretary for testing, upon completion of the technology demonstration activities; and

(3) based upon the principle that the high-level radioactive waste, spent nuclear fuel, or other radioactive material involved shall be isolated from the biosphere in such a way that the

initial isolation is provided by engineered barriers functioning as a system with the geologic environment.

Testing

(c) OPERATION.—(1) Not later than 88 months after the date of the enactment of this Act, the Secretary shall begin an in situ testing program at the test and evaluation facility in accordance with the mission plan developed under section 301, for purposes of—

(A) conducting in situ tests of bore hole sealing, geologic media fracture sealing, and room closure to establish the techniques and performance for isolation of high-level radioactive waste, spent nuclear fuel, or other radioactive materials from the biosphere;

(B) conducting in situ tests with radioactive sources and materials to evaluate and improve reliable models for radionuclide migration, absorption, and containment within the engineered barriers and geologic media involved, if the Secretary finds there is reasonable assurance that such radioactive sources and materials will not threaten the use of such site as a repository;

(C) conducting in situ tests to evaluate and improve models for ground water or brine flow through fractured geologic media;

(D) conducting in situ tests under conditions representing the real time and the accelerated time behavior of the engineered barriers within the geologic environment involved;

(E) conducting in situ tests to evaluate the effects of heat and pressure on the geologic media involved, on the hydrology of the surrounding area, and on the integrity of the disposal packages;

(F) conducting in situ tests under both normal and abnormal repository conditions to establish safe design limits for disposal packages and to determine the effects of the gross release of radionuclides into surroundings, and the effects of various credible failure modes, including—

(i) seismic events leading to the coupling of aquifers through the test and evaluation facility;

(ii) thermal pulses significantly greater than the maximum calculated; and

(iii) human intrusion creating a direct pathway to the biosphere; and

(G) conducting such other research and development activities as the Secretary considers appropriate, including such activities necessary to obtain the use of high-level radioactive waste, spent nuclear fuel, or other radioactive materials (such as any highly radioactive material from the Three Mile Island nuclear powerplant or from the West Valley Demonstration Project) for test and evaluation purposes, if such other activities are reasonably necessary to support the repository program and if there is reasonable assurance that the radioactive sources involved will not threaten the use of such site as a repository.

(2) The in situ testing authorized in this subsection shall be designed to ensure that the suitability of the site involved for licensing by the Commission as a repository will not be adversely affected.

(d) USE OF EXISTING DEPARTMENT FACILITIES.—During the conducting of siting research activities under section 214 and for such period thereafter as the Secretary considers appropriate, the Secretary shall use Department facilities owned by the Federal Government on the date of the enactment of this Act for the conducting of

generically applicable tests regarding packaging, handling, and emplacement technology for solidified high-level radioactive waste and spent nuclear fuel from civilian nuclear activities.

(e) ENGINEERED BARRIERS.—The system of engineered barriers and selected geology used in a test and evaluation facility shall have a design life at least as long as that which the Commission requires by regulations issued under this Act, or under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), for repositories.

(f) ROLE OF COMMISSION.—(1)(A) Not later than 1 year after the date of the enactment of this Act, the Secretary and the Commission shall reach a written understanding establishing the procedures for review, consultation, and coordination in the planning, construction, and operation of the test and evaluation facility under this section. Such understanding shall establish a schedule, consistent with the deadlines set forth in this subtitle, for submission by the Secretary of, and review by the Commission of and necessary action on—

(i) the mission plan prepared under section 301; and

(ii) such reports and other information as the Commission may reasonably require to evaluate any health and safety impacts of the test and evaluation facility.

(B) Such understanding shall also establish the conditions under which the Commission may have access to the test and evaluation facility for the purpose of assessing any public health and safety concerns that it may have. No shafts may be excavated for the test and evaluation until the Secretary and the Commission enter into such understanding.

(2) Subject to section 305, the test and evaluation facility, and the facilities authorized in section 217, shall be constructed and operated as research, development, and demonstration facilities, and shall not be subject to licensing under section 202 of the Energy Reorganization Act of 1974 (42 U.S.C. 5842).

(3)(A) The Commission shall carry out a continuing analysis of the activities undertaken under this section to evaluate the adequacy of the consideration of public health and safety issues.

(B) The Commission shall report to the President, the Secretary, and the Congress as the Commission considers appropriate with respect to the conduct of activities under this section.

(g) ENVIRONMENTAL REVIEW.—The Secretary shall prepare an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)) prior to conducting tests with radioactive materials at the test and evaluation facility. Such environmental impact statement shall incorporate, to the extent practicable, the environmental assessment prepared under section 217(a). Nothing in this subsection may be construed to limit siting research activities conducted under section 214. This subsection shall apply only to activities performed exclusively for a test and evaluation facility.

(h) LIMITATIONS.—(1) If the test and evaluation facility is not located at the site of a repository, the Secretary shall obtain the concurrence of the Commission with respect to the decontamination and decommissioning of such facility.

(2) If the test and evaluation facility is not located at a candidate site or repository site, the Secretary shall conduct only the portion of the in situ testing program required in subsection (c) determined by the Secretary to be useful in carrying out the purposes of this Act.

Termination.

(3) The operation of the test and evaluation facility shall terminate not later than—

(A) 5 years after the date on which the initial repository begins operation; or

(B) at such time as the Secretary determines that the continued operation of a test and evaluation facility is not necessary for research, development, and demonstration purposes;

whichever occurs sooner.

(4) Notwithstanding any other provisions of this subsection, as soon as practicable following any determination by the Secretary, with the concurrence of the Commission, that the test and evaluation facility is unsuitable for continued operation, the Secretary shall take such actions as are necessary to remove from such site any radioactive material placed on such site as a result of testing and evaluation activities conducted under this section. Such requirement may be waived if the Secretary, with the concurrence of the Commission, finds that short-term testing and evaluation activities using radioactive material will not endanger the public health and safety.

RESEARCH AND DEVELOPMENT ON SPENT NUCLEAR FUEL

42 USC 10198.

SEC. 218. (a) DEMONSTRATION AND COOPERATIVE PROGRAMS.—The Secretary shall establish a demonstration program, in cooperation with the private sector, for the dry storage of spent nuclear fuel at civilian nuclear power reactor sites, with the objective of establishing one or more technologies that the Commission may, by rule, approve for use at the sites of civilian nuclear power reactors without, to the maximum extent practicable, the need for additional site-specific approvals by the Commission. Not later than 1 year after the date of the enactment of this Act, the Secretary shall select at least 1, but not more than 3, sites evaluated under section 214 at such power reactors. In selecting such site or sites, the Secretary shall give preference to civilian nuclear power reactors that will soon have a shortage of interim storage capacity for spent nuclear fuel. Subject to reaching agreement as provided in subsection (b), the Secretary shall undertake activities to assist such power reactors with demonstration projects at such sites, which may use one of the following types of alternate storage technologies: spent nuclear fuel storage casks, caissons, or silos. The Secretary shall also undertake a cooperative program with civilian nuclear power reactors to encourage the development of the technology for spent nuclear fuel rod consolidation in existing power reactor water storage basins.

(b) COOPERATIVE AGREEMENTS.—To carry out the programs described in subsection (a), the Secretary shall enter into a cooperative agreement with each utility involved that specifies, at a minimum, that—

(1) such utility shall select the alternate storage technique to be used, make the land and spent nuclear fuel available for the dry storage demonstration, submit and provide site-specific documentation for a license application to the Commission, obtain a license relating to the facility involved, construct such facility, operate such facility after licensing, pay the costs required to construct such facility, and pay all costs associated with the operation and maintenance of such facility;

(2) the Secretary shall provide, on a cost-sharing basis, consultative and technical assistance, including design support

and generic licensing documentation, to assist such utility in obtaining the construction authorization and appropriate license from the Commission; and

(3) the Secretary shall provide generic research and development of alternative spent nuclear fuel storage techniques to enhance utility-provided, at-reactor storage capabilities, if authorized in any other provision of this Act or in any other provision of law.

(c) DRY STORAGE RESEARCH AND DEVELOPMENT.—(1) The consultative and technical assistance referred to in subsection (b)(2) may include, but shall not be limited to, the establishment of a research and development program for the dry storage of not more than 300 metric tons of spent nuclear fuel at facilities owned by the Federal Government on the date of the enactment of this Act. The purpose of such program shall be to collect necessary data to assist the utilities involved in the licensing process.

(2) To the extent available, and consistent with the provisions of section 135, the Secretary shall provide spent nuclear fuel for the research and development program authorized in this subsection from spent nuclear fuel received by the Secretary for storage under section 135. Such spent nuclear fuel shall not be subject to the provisions of section 135(e).

(d) FUNDING.—The total contribution from the Secretary from Federal funds and the use of Federal facilities or services shall not exceed 25 percent of the total costs of the demonstration program authorized in subsection (a), as estimated by the Secretary. All remaining costs of such program shall be paid by the utilities involved or shall be provided by the Secretary from the Interim Storage Fund established in section 136.

(e) RELATION TO SPENT NUCLEAR FUEL STORAGE PROGRAM.—The spent nuclear fuel storage program authorized in section 135 shall not be construed to authorize the use of research development or demonstration facilities owned by the Department unless—

(1) a period of 30 calendar days (not including any day in which either House of Congress is not in session because of adjournment of more than 3 calendar days to a day certain) has passed after the Secretary has transmitted to the Committee on Science and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a written report containing a full and complete statement concerning (A) the facility involved; (B) any necessary modifications; (C) the cost thereof; and (D) the impact on the authorized research and development program; or

Report to congressional committees.

(2) each such committee, before the expiration of such period, has transmitted to the Secretary a written notice to the effect that such committee has no objection to the proposed use of such facility.

PAYMENTS TO STATES AND INDIAN TRIBES

SEC. 219. (a) PAYMENTS.—Subject to subsection (b), the Secretary shall make payments to each State or affected Indian tribe that has entered into an agreement pursuant to section 215. The Secretary shall pay an amount equal to 100 percent of the expenses incurred by such State or Indian tribe in engaging in any monitoring, testing, evaluation, or other consultation and cooperation activity under section 215 with respect to any site. The amount paid by the

42 USC 10199.

Secretary under this paragraph shall not exceed $3,000,000 per year from the date on which the site involved was identified to the date on which the decontamination and decommission of the facility is complete pursuant to section 217(h). Any such payment may only be made to a State in which a potential site for a test and evaluation facility has been identified under section 213, or to an affected Indian tribe where the potential site has been identified under such section.

(b) LIMITATION.—The Secretary shall make any payment to a State under subsection (a) only if such State agrees to provide, to each unit of general local government within the jurisdictional boundaries of which the potential site or effectively selected site involved is located, at least one-tenth of the payments made by the Secretary to such State under such subsection. A State or affected Indian tribe receiving any payment under subsection (a) shall otherwise have discretion to use such payment for whatever purpose it deems necessary, including the State or tribal activities pursuant to agreements entered into in accordance with section 215. Annual payments shall be prorated on a 365-day basis to the specified dates.

STUDY OF RESEARCH AND DEVELOPMENT NEEDS FOR MONITORED RETRIEVABLE STORAGE PROPOSAL

Report to Congress.
42 USC 10200

SEC. 220. Not later than 6 months after the date of the enactment of this Act, the Secretary shall submit to the Congress a report describing the research and development activities the Secretary considers necessary to develop the proposal required in section 141(b) with respect to a monitored retrievable storage facility.

JUDICIAL REVIEW

42 USC 10201.

SEC. 221. Judicial review of research and development activities under this title shall be in accordance with the provisions of section 119.

Ante, p. 2227.

42 USC 10202.

SEC. 222. RESEARCH ON ALTERNATIVES FOR THE PERMANENT DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE.—The Secretary shall continue and accelerate a program of research, development, and investigation of alternative means and technologies for the permanent disposal of high-level radioactive waste from civilian nuclear activities and Federal research and development activities except that funding shall be made from amounts appropriated to the Secretary for purposes of carrying out this section. Such program shall include examination of various waste disposal options.

TECHNICAL ASSISTANCE TO NON-NUCLEAR WEAPON STATES IN THE FIELD OF SPENT FUEL STORAGE AND DISPOSAL

42 USC 10203.

SEC. 223. (a) It shall be the policy of the United States to cooperate with and provide technical assistance to non-nuclear weapon states in the field of spent fuel storage and disposal.

Joint notice, publication in Federal Register

(b)(1) Within 90 days of enactment of this Act, the Secretary and the Commission shall publish a joint notice in the Federal Register stating that the United States is prepared to cooperate with and provide technical assistance to non-nuclear weapon states in the fields of at-reactor spent fuel storage; away-from-reactor spent fuel storage; monitored, retrievable spent fuel storage; geologic disposal of spent fuel; and the health, safety, and environmental regulation

of such activities. The notice shall summarize the resources that can be made available for international cooperation and assistance in these fields through existing programs of the Department and the Commission, including the availability of: (i) data from past or ongoing research and development projects; (ii) consultations with expert Department or Commission personnel or contractors; and (iii) liaison with private business entities and organizations working in these fields.

(2) The joint notice described in the preceding subparagraph shall be updated and reissued annually for 5 succeeding years. Joint notice, reissuance.

(c) Following publication of the annual joint notice referred to in paragraph (2), the Secretary of State shall inform the governments of non-nuclear weapon states and, as feasible, the organizations operating nuclear powerplants in such states, that the United States is prepared to cooperate with and provide technical assistance to non-nuclear weapon states in the fields of spent fuel storage and disposal, as set forth in the joint notice. The Secretary of State shall also solicit expressions of interest from non-nuclear weapon state governments and non-nuclear weapon state nuclear power reactor operators concerning their participation in expanded United States cooperation and technical assistance programs in these fields. The Secretary of State shall transmit any such expressions of interest to the Department and the Commission. Expressions of interest.

(d) With his budget presentation materials for the Department and the Commission for fiscal years 1984 through 1989, the President shall include funding requests for an expanded program of cooperation and technical assistance with non-nuclear weapon states in the fields of spent fuel storage and disposal as appropriate in light of expressions of interest in such cooperation and assistance on the part of non-nuclear weapon state governments and non-nuclear weapon state nuclear power reactor operators.

(e) For the purposes of this subsection, the term "non-nuclear weapon state" shall have the same meaning as that set forth in article IX of the Treaty on the Non-Proliferation of Nuclear Weapons (21 U.S.C. 438). "Non-nuclear weapon state."

(f) Nothing in this subsection shall authorize the Department or the Commission to take any action not authorized under existing law.

TITLE III—OTHER PROVISIONS RELATING TO RADIOACTIVE WASTE

MISSION PLAN

SEC. 301. (a) CONTENTS OF MISSION PLAN.—The Secretary shall prepare a comprehensive report, to be known as the mission plan, which shall provide an informational basis sufficient to permit informed decisions to be made in carrying out the repository program and the research, development, and demonstration programs required under this Act. The mission plan shall include— 42 USC 10221.

(1) an identification of the primary scientific, engineering, and technical information, including any necessary demonstration of engineering or systems integration, with respect to the siting and construction of a test and evaluation facility and repositories;

(2) an identification of any information described in paragraph (1) that is not available because of any unresolved scien-

tific, engineering, or technical questions, or undemonstrated engineering or systems integration, a schedule including specific major milestones for the research, development, and technology demonstration program required under this Act and any additional activities to be undertaken to provide such information, a schedule for the activities necessary to achieve important programmatic milestones, and an estimate of the costs required to carry out such research, development, and demonstration programs;

(3) an evaluation of financial, political, legal, or institutional problems that may impede the implementation of this Act, the plans of the Secretary to resolve such problems, and recommendations for any necessary legislation to resolve such problems;

(4) any comments of the Secretary with respect to the purpose and program of the test and evaluation facility;

(5) a discussion of the significant results of research and development programs conducted and the implications for each of the different geologic media under consideration for the siting of repositories, and, on the basis of such information, a comparison of the advantages and disadvantages associated with the use of such media for repository sites;

Ante, p. 2208.

(6) the guidelines issued under section 112(a);

(7) a description of known sites at which site characterization activities should be undertaken, a description of such siting characterization activities, including the extent of planned excavations, plans for onsite testing with radioactive or nonradioactive material, plans for any investigations activities which may affect the capability of any such site to isolate high-level radioactive waste or spent nuclear fuel, plans to control any adverse, safety-related impacts from such site characterization activities, and plans for the decontamination and decommissioning of such site if it is determined unsuitable for licensing as a repository;

(8) an identification of the process for solidifying high-level radioactive waste or packaging spent nuclear fuel, including a summary and analysis of the data to support the selection of the solidification process and packaging techniques, an analysis of the requirements for the number of solidification packaging facilities needed, a description of the state of the art for the materials proposed to be used in packaging such waste or spent fuel and the availability of such materials including impacts on strategic supplies and any requirements for new or reactivated facilities to produce any such materials needed, and a description of a plan, and the schedule for implementing such plan, for an aggressive research and development program to provide when needed a high-integrity disposal package at a reasonable price;

(9) an estimate of (A) the total repository capacity required to safely accommodate the disposal of all high-level radioactive waste and spent nuclear fuel expected to be generated through December 31, 2020, in the event that no commercial reprocessing of spent nuclear fuel occurs, as well as the repository capacity that will be required if such reprocessing does occur; (B) the number and type of repositories required to be constructed to provide such disposal capacity; (C) a schedule for the construction of such repositories; and (D) an estimate of the period during which each repository listed in such schedule will

be accepting high-level radioactive waste or spent nuclear fuel for disposal;

(10) an estimate, on an annual basis, of the costs required (A) to construct and operate the repositories anticipated to be needed under paragraph (9) based on each of the assumptions referred to in such paragraph; (B) to construct and operate a test and evaluation facility, or any other facilities, other than repositories described in subparagraph (A), determined to be necessary; and (C) to carry out any other activities under this Act; and

(11) an identification of the possible adverse economic and other impacts to the State or Indian tribe involved that may arise from the development of a test and evaluation facility or repository at a site.

(b) SUBMISSION OF MISSION PLAN.—(1) Not later than 15 months after the date of the enactment of this Act, the Secretary shall submit a draft mission plan to the States, the affected Indian tribes, the Commission, and other Government agencies as the Secretary deems appropriate for their comments.

(2) In preparing any comments on the mission plan, such agencies shall specify with precision any objections that they may have. Upon submission of the mission plan to such agencies, the Secretary shall publish a notice in the Federal Register of the submission of the mission plan and of its availability for public inspection, and, upon receipt of any comments of such agencies respecting the mission plan, the Secretary shall publish a notice in the Federal Register of the receipt of comments and of the availability of the comments for public inspection. If the Secretary does not revise the mission plan to meet objections specified in such comments, the Secretary shall publish in the Federal Register a detailed statement for not so revising the mission plan.

Publication in Federal Register

(3) The Secretary, after reviewing any other comments made by such agencies and revising the mission plan to the extent that the Secretary may consider to be appropriate, shall submit the mission plan to the appropriate committees of the Congress not later than 17 months after the date of the enactment of this Act. The mission plan shall be used by the Secretary at the end of the first period of 30 calendar days (not including any day on which either House of Congress is not in session because of adjournment of more than 3 calendar days to a day certain) following receipt of the mission plan by the Congress.

Plan submittal to congressional committees

NUCLEAR WASTE FUND

SEC. 302. (a) CONTRACTS.—(1) In the performance of his functions under this Act, the Secretary is authorized to enter into contracts with any person who generates or holds title to high-level radioactive waste, or spent nuclear fuel, of domestic origin for the acceptance of title, subsequent transportation, and disposal of such waste or spent fuel. Such contracts shall provide for payment to the Secretary of fees pursuant to paragraphs (2) and (3) sufficient to offset expenditures described in subsection (d).

42 USC 10222

Fees

(2) For electricity generated by a civilian nuclear power reactor and sold on or after the date 90 days after the date of enactment of this Act, the fee under paragraph (1) shall be equal to 1.0 mil per kilowatt-hour.

Fees

(3) For spent nuclear fuel, or solidified high-level radioactive waste derived from spent nuclear fuel, which fuel was used to generate electricity in a civilian nuclear power reactor prior to the application of the fee under paragraph (2) to such reactor, the Secretary shall, not later than 90 days after the date of enactment of this Act, establish a 1 time fee per kilogram of heavy metal in spent nuclear fuel, or in solidified high-level radioactive waste. Such fee shall be in an amount equivalent to an average charge of 1.0 mil per kilowatt-hour for electricity generated by such spent nuclear fuel, or such solidified high-level waste derived therefrom, to be collected from any person delivering such spent nuclear fuel or high-level waste, pursuant to section 123, to the Federal Government. Such fee shall be paid to the Treasury of the United States and shall be deposited in the separate fund established by subsection (c) 126(b). In paying such a fee, the person delivering spent fuel, or solidified high-level radioactive wastes derived therefrom, to the Federal Government shall have no further financial obligation to the Federal Government for the long-term storage and permanent disposal of such spent fuel, or the solidified high-level radioactive waste derived therefrom.

Ante, p. 2229

Collection and payment procedures. Review.

(4) Not later than 180 days after the date of enactment of this Act, the Secretary shall establish procedures for the collection and payment of the fees established by paragraph (2) and paragraph (3). The Secretary shall annually review the amount of the fees established by paragraphs (2) and (3) above to evaluate whether collection of the fee will provide sufficient revenues to offset the costs as defined in subsection (d) herein. In the event the Secretary determines that either insufficient or excess revenues are being collected, in order to recover the costs incurred by the Federal Government that are specified in subsection (d), the Secretary shall propose an adjustment to the fee to insure full cost recovery. The Secretary shall immediately transmit this proposal for such an adjustment to Congress. The adjusted fee proposed by the Secretary shall be effective after a period of 90 days of continuous session have elapsed following the receipt of such transmittal unless during such 90-day period either House of Congress adopts a resolution disapproving the Secretary's proposed adjustment in accordance with the procedures set forth for congressional review of an energy action under section 551 of the Energy Policy and Conservation Act.

Transmittal to Congress.

42 USC 6421.

(5) Contracts entered into under this section shall provide that—

(A) following commencement of operation of a repository, the Secretary shall take title to the high-level radioactive waste or spent nuclear fuel involved as expeditiously as practicable upon the request of the generator or owner of such waste or spent fuel; and

(B) in return for the payment of fees established by this section, the Secretary, beginning not later than January 31, 1998, will dispose of the high-level radioactive waste or spent nuclear fuel involved as provided in this subtitle.

Disposal services, terms and conditions.

(6) The Secretary shall establish in writing criteria setting forth the terms and conditions under which such disposal services shall be made available.

License renewal or issuance.

(b) ADVANCE CONTRACTING REQUIREMENT.—(1)(A) The Commission shall not issue or renew a license to any person to use a utilization or production facility under the authority of section 103 or 104 of the Atomic Energy Act of 1954 (42 U.S.C. 2133, 2134) unless—

(i) such person has entered into a contract with the Secretary under this section; or

(ii) the Secretary affirms in writing that such person is actively and in good faith negotiating with the Secretary for a contract under this section.

(B) The Commission, as it deems necessary or appropriate, may require as a precondition to the issuance or renewal of a license under section 103 or 104 of the Atomic Energy Act of 1954 (42 U.S.C. 2133, 2134) that the applicant for such license shall have entered into an agreement with the Secretary for the disposal of high-level radioactive waste and spent nuclear fuel that may result from the use of such license.

(2) Except as provided in paragraph (1), no spent nuclear fuel or high-level radioactive waste generated or owned by any person (other than a department of the United States referred to in section 101 or 102 of title 5, United States Code) may be disposed of by the Secretary in any repository constructed under this Act unless the generator or owner of such spent fuel or waste has entered into a contract with the Secretary under this section by not later than—

(A) June 30, 1983; or

(B) the date on which such generator or owner commences generation of, or takes title to, such spent fuel or waste;

whichever occurs later.

(3) The rights and duties of a party to a contract entered into under this section may be assignable with transfer of title to the spent nuclear fuel or high-level radioactive waste involved.

Disposal of radioactive waste or spent nuclear fuel

(4) No high-level radioactive waste or spent nuclear fuel generated or owned by any department of the United States referred to in section 101 or 102 of title 5, United States Code, may be disposed of by the Secretary in any repository constructed under this Act unless such department transfers to the Secretary, for deposit in the Nuclear Waste Fund, amounts equivalent to the fees that would be paid to the Secretary under the contracts referred to in this section if such waste or spent fuel were generated by any other person.

(c) ESTABLISHMENT OF NUCLEAR WASTE FUND.—There hereby is established in the Treasury of the United States a separate fund, to be known as the Nuclear Waste Fund. The Waste Fund shall consist of—

(1) all receipts, proceeds, and recoveries realized by the Secretary under subsections (a), (b), and (e), which shall be deposited in the Waste Fund immediately upon their realization;

(2) any appropriations made by the Congress to the Waste Fund; and

(3) any unexpended balances available on the date of the enactment of this Act for functions or activities necessary or incident to the disposal of civilian high-level radioactive waste or civilian spent nuclear fuel, which shall automatically be transferred to the Waste Fund on such date.

(d) USE OF WASTE FUND.—The Secretary may make expenditures from the Waste Fund, subject to subsection (e), only for purposes of radioactive waste disposal activities under titles I and II, including—

Ante, pp. 2206, 2245.

(1) the identification, development, licensing, construction, operation, decommissioning, and post-decommissioning maintenance and monitoring of any repository, monitored, retrievable storage facility or test and evaluation facility constructed under this Act;

(2) the conducting of nongeneric research, development, and demonstration activities under this Act;

(3) the administrative cost of the radioactive waste disposal program;

(4) any costs that may be incurred by the Secretary in connection with the transportation, treating, or packaging of spent nuclear fuel or high-level radioactive waste to be disposed of in a repository, to be stored in a monitored, retrievable storage site or to be used in a test and evaluation facility;

(5) the costs associated with acquisition, design, modification, replacement, operation, and construction of facilities at a repository site, a monitored, retrievable storage site or a test and evaluation facility site and necessary or incident to such repository, monitored, retrievable storage facility or test and evaluation facility; and

(6) the provision of assistance to States, units of general local government, and Indian tribes under sections 116, 118, and 219.

Ante, pp. 2220, 2225, 2253

No amount may be expended by the Secretary under this subtitle for the construction or expansion of any facility unless such construction or expansion is expressly authorized by this or subsequent legislation. The Secretary hereby is authorized to construct one repository and one test and evaluation facility.

Report to Congress.

(e) ADMINISTRATION OF WASTE FUND.—(1) The Secretary of the Treasury shall hold the Waste Fund and, after consultation with the Secretary, annually report to the Congress on the financial condition and operations of the Waste Fund during the preceding fiscal year.

Budget submittal.

(2) The Secretary shall submit the budget of the Waste Fund to the Office of Management and Budget triennially along with the budget of the Department of Energy submitted at such time in accordance with chapter 11 of title 31, United States Code. The budget of the Waste Fund shall consist of the estimates made by the Secretary of expenditures from the Waste Fund and other relevant financial matters for the succeeding 3 fiscal years, and shall be included in the Budget of the United States Government. The Secretary may make expenditures from the Waste Fund, subject to appropriations which shall remain available until expended. Appropriations shall be subject to triennial authorization.

Ante, p. 907.

(3) If the Secretary determines that the Waste Fund contains at any time amounts in excess of current needs, the Secretary may request the Secretary of the Treasury to invest such amounts, or any portion of such amounts as the Secretary determines to be appropriate, in obligations of the United States—

(A) having maturities determined by the Secretary of the Treasury to be appropriate to the needs of the Waste Fund; and

(B) bearing interest at rates determined to be appropriate by the Secretary of the Treasury, taking into consideration the current average market yield on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the maturities of such investments, except that the interest rate on such investments shall not exceed the average interest rate applicable to existing borrowings

(4) Receipts, proceeds, and recoveries realized by the Secretary under this section, and expenditures of amounts from the Waste Fund, shall be exempt from annual apportionment under the provisions of subchapter II of chapter 15 of title 31, United States Code.

Ante, p. 927

(5) If at any time the moneys available in the Waste Fund are insufficient to enable the Secretary to discharge his responsibilities under this subtitle, the Secretary shall issue to the Secretary of the Treasury obligations in such forms and denominations, bearing such maturities, and subject to such terms and conditions as may be agreed to by the Secretary and the Secretary of the Treasury. The total of such obligations shall not exceed amounts provided in appropriation Acts. Redemption of such obligations shall be made by the Secretary from moneys available in the Waste Fund. Such obligations shall bear interest at a rate determined by the Secretary of the Treasury, which shall be not less than a rate determined by taking into consideration the average market yield on outstanding marketable obligations of the United States of comparable maturities during the month preceding the issuance of the obligations under this paragraph. The Secretary of the Treasury shall purchase any issued obligations, and for such purpose the Secretary of the Treasury is authorized to use as a public debt transaction the proceeds from the sale of any securities issued under chapter 31 of title 31, United States Code, and the purposes for which securities may be issued under such Act are extended to include any purchase of such obligations. The Secretary of the Treasury may at any time sell any of the obligations acquired by him under this paragraph All redemptions, purchases, and sales by the Secretary of the Treasury of obligations under this paragraph shall be treated as public debt transactions of the United States.

Ante, p. 937

(6) Any appropriations made available to the Waste Fund for any purpose described in subsection (d) shall be repaid into the general fund of the Treasury, together with interest from the date of availability of the appropriations until the date of repayment. Such interest shall be paid on the cumulative amount of appropriations available to the Waste Fund, less the average undisbursed cash balance in the Waste Fund account during the fiscal year involved. The rate of such interest shall be determined by the Secretary of the Treasury taking into consideration the average market yield during the month preceding each fiscal year on outstanding marketable obligations of the United States of comparable maturity. Interest payments may be deferred with the approval of the Secretary of the Treasury, but any interest payments so deferred shall themselves bear interest.

Interest payments

Deferral

ALTERNATIVE MEANS OF FINANCING

SEC. 303. The Secretary shall undertake a study with respect to alternative approaches to managing the construction and operation of all civilian radioactive waste management facilities, including the feasibility of establishing a private corporation for such purposes. In conducting such study, the Secretary shall consult with the Director of the Office of Management and Budget, the Chairman of the Commission, and such other Federal agency representatives as may be appropriate. Such study shall be completed, and a report containing the results of such study shall be submitted to the Congress, within 1 year after the date of the enactment of this Act.

Study
42 USC 10223

Report to Congress.

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

SEC. 304. (a) ESTABLISHMENT.—There hereby is established within the Department of Energy an Office of Civilian Radioactive Waste

42 USC 10224

Management. The Office shall be headed by a Director, who shall be appointed by the President, by and with the advice and consent of the Senate, and who shall be compensated at the rate payable for level IV of the Executive Schedule under section 5315 of title 5, United States Code.

(b) FUNCTIONS OF DIRECTOR.—The Director of the Office shall be responsible for carrying out the functions of the Secretary under this Act, subject to the general supervision of the Secretary. The Director of the Office shall be directly responsible to the Secretary.

(c) ANNUAL REPORT TO CONGRESS.—The Director of the Office shall annually prepare and submit to the Congress a comprehensive report on the activities and expenditures of the Office.

(d) ANNUAL AUDIT BY COMPTROLLER GENERAL.—The Comptroller General of the United States shall annually make an audit of the Office, in accordance with such regulations as the Comptroller General may prescribe. The Comptroller General shall have access to such books, records, accounts, and other materials of the Office as the Comptroller General determines to be necessary for the preparation of such audit. The Comptroller General shall submit to the Congress a report on the results of each audit conducted under this section.

Report to Congress

LOCATION OF TEST AND EVALUATION FACILITY

42 USC 10225.

SEC. 305. (a) REPORT TO CONGRESS.—Not later than 1 year after the date of the enactment of this Act, the Secretary shall transmit to the Congress a report setting forth whether the Secretary plans to locate the test and evaluation facility at the site of a repository.

(b) PROCEDURES.—(1) If the test and evaluation facility is to be located at any candidate site or repository site (A) site selection and development of such facility shall be conducted in accordance with the procedures and requirements established in title I with respect to the site selection and development of repositories; and (B) the Secretary may not commence construction of any surface facility for such test and evaluation facility prior to issuance by the Commission, of a construction authorization for a repository at the site involved.

Ante, p. 2206

(2) No test and evaluation facility may be converted into a repository unless site selection and development of such facility was conducted in accordance with the procedures and requirements established in title I with respect to the site selection and development of respositories.

(3) The Secretary may not commence construction of a test and evaluation facility at a candidate site or site recommended as the location for a repository prior to the date on which the designation of such site is effective under section 115.

Ante, p. 2217

NUCLEAR REGULATORY COMMISSION TRAINING AUTHORIZATION

Regulations or guidance
42 USC 10226

SEC. 306. NUCLEAR REGULATORY COMMISSION TRAINING AUTHORIZATION.—The Nuclear Regulatory Commission is authorized and directed to promulgate regulations, or other appropriate Commission regulatory guidance, for the training and qualifications of civilian nuclear powerplant operators, supervisors, technicians and other appropriate operating personnel. Such regulations or guidance shall establish simulator training requirements for applicants for civilian nuclear powerplant operator licenses and for operator re-

qualification programs; requirements governing NRC administration of requalification examinations; requirements for operating tests at civilian nuclear powerplant simulators, and instructional requirements for civilian nuclear powerplant licensee personnel training programs. Such regulations or other regulatory guidance shall be promulgated by the Commission within the 12-month period following enactment of this Act, and the Commission within the 12-month period following enactment of this Act shall submit a report to Congress setting forth the actions the Commission has taken with respect to fulfilling its obligations under this section.

Report to Congress

Approved January 7, 1983.

LEGISLATIVE HISTORY—H.R. 3809:

HOUSE REPORT No. 97-491 pt.1 (Comm. on Interior and Insular Affairs) and pt. 2 (Comm. on Armed Services).

CONGRESSIONAL RECORD, Vol. 128 (1982):
Sept. 30, Nov. 29, 30, Dec. 2, considered and passed House.
Dec. 20, considered and passed Senate, amended, House agreed to Senate amendments.

WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 19, No. 1 (1983):
Jan. 7, Presidential statement.

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OCRWM

Office of Civilian Radioactive Waste Management

In 1982 Congress passed the Nuclear Waste Policy Act that established the nation's nuclear waste program. The Office of Civilian Radioactive Waste Management was created by the act to fulfill the Congressional mandate. The program is funded by the generators and consumers of nuclear electricity and by the nation's defense activities. For further information about the national program, write to:

U.S. Department of Energy
Office of Civilian Radioactive
Waste Management (RW-40)
1000 Independence Avenue, S.W.
Washington, D.C. 20585
(202) 252-5722

or

U.S. Department of Energy
Oak Ridge Operations Office,
MRS Office
P.O. Box E
Oak Ridge, Tennessee 37831
(615) 576-6694

For additional information about specific site studies, write to:

Salt Project

Salt Repository Project Office
U.S. Department of Energy
505 King Avenue
Columbus, Ohio 43201-2693
(614) 424-5916

Basalt Project

Public Affairs Director
U.S. Department of Energy
Richland, Washington 99352
(509) 376-7501

Tuff Project

Public Affairs Office
U.S. Department of Energy
Box 14100
Las Vegas, Nevada 89114
(702) 295-3521

Crystalline Project

Crystalline Repository
Project Office
U.S. Department of Energy
9800 South Cass Avenue
Argonne, Illinois 60439
(312) 972-2570

APPENDIX B

April 4, 1984	Letter to Dr. Sally Mann concerning Screening Process
June 22, 1984	Letter to Charles Head concerning comments on "Mission Plan"
October 29, 1984	Letter to Dr. Sally Mann concerning Region-to-Area Screening Methodology
April 5, 1985	Letter to Dr. Sally Mann concerning Regional Characterization Reports
April 15, 1986	Letter to Dr. Sally Mann concerning comments on the draft Area Recommendation Report
October 23, 1986	Letter to J. Dexter Peach concerning GAO report on Institutional Relations Under The Nuclear Waste Policy Act of 1982

The Commonwealth of Massachusetts
Executive Office of Human Services
Department of Public Health
150 Tremont Street
Boston 02111 Tel: 727-6214

Bailus Walker, Jr., Ph.D., M.P.H.
Commissioner

Seventh Floor

April 24, 1984

Dr. Sally Mann
Crystalline Rock Project Office
U.S. Department of Energy
Chicago Operations Office
9800 South Cass Ave.
Argonne, Illinois 60439

Dear Dr. Mann:

We appreciated the opportunity to attend and participate in the Crystalline Rock Project Workshop in Atlanta. The process proved to be a usefull one and we feel some very worthwhile points were made.

Attached are our comments and concerns arising from the workshop which we hope will verify our support of some of the changes suggested for incorporation into the screening methodology.

We would like to thank you and your staff for your continued accommodation of the states concerns, and hope there will be more opportunities for interaction prior to finalization of the screening process.

Sincerely,

Robert M. Hallisey, Director
Radiation Control Program.

RMH/bb

ENVIRONMENTAL COMMENTS

First, as discussed in the environmental subcommittee sections, we advocate the use of a standard scale with equal scale increments, such as that proposed by Minnesota. The Minnesota scale diminishes the skewing affect of the proposed OCRD scales, providing a logical physical and numerical center of 3.0.

The following presents our areas of agreement and disagreement with Minnesota's proposed scales for the environmental variables. We agree with the scales suggested for:

- Proposed federal protected lands
- Proposed state protected lands
- National and state protected forest lands
- Designated critical habitat for threatened and endangered species
- Wetlands
- Flood potential
- Surface water bodies

Below are the environmental screening variables which we feel would be better addressed by using different scale increments that those proposed by Minnesota.

- Proximity to federal protected lands: Equal two mile scale increments would provide greater uniformity with the other variables.

- Proximity to state protected lands: The same as above.

- Proximity to population: We agree with the scale increments proposed in the environmental committee section, that is, equal increments of twelve (12) ranging from zero (0) to forty-eight (48).

- Transportation: This variable escaped full discussion at the Atlanta Workshop, however we do feel it should be included in the region-to-area screening process, as a step 2 variable. The most favorable location would be of little value if it were inaccessible, requiring the construction of a substantial transportation network just to reach the site. Thus it is necessary on a gross regional scale to include rail and transportation systems as screening variable.

It is assumed that the location of a major transportation route within the control zone is more favorable than having a major route outside the control zone, then the Minnesota scale provides a logical approach. An exception to this is to have the most adverse condition as "greater than" six, not "less than" six as indicated in the Minnesota report.

The physical condition of the transportation systems, railway abandonment status, and rail capacity, would be more effectively addressed at a later stage in the screening process.

Weighting Process

In regard to the development of a weighting process, we offer the following thoughts. One way to proceed in this area may be for OCRD, along with outside experts, to establish preliminary weighting scenarios with access for state review and comment. Subsequently, the opportunity to participate in a workshop or series of workshops, similar to those used for screening methodology would be beneficial to both the states and OCRD for final decisions regarding appropriate weights. Massachusetts looks forward to participating in any such interactive process designed by OCRD.

The Commonwealth of Massachusetts
Executive Office of Human Services
Department of Public Health
150 Tremont Street
Boston 02111 Tel: 727-6214

Bailus Walker, Jr., Ph.D., M.P.H.
Commissioner, Seventh Floor

June 22, 1984

Charles Head, Acting Director
Operations Division, Office of Civilian
Radioactive Waste Management
U.S. Department of Energy, RW-13
Forrestal Building
100 Independence Avenue
Washington, DC. 20585

Dear Mr. Head:

Massachusetts appreciates the opportunity to review and comment on the April 1984 draft of the "Mission Plan for the Civilian Radioactive Waste Management Program." Our review efforts have focused on Volume I of the Plan and primarily addresses the program's schedule, as well as issues which may deserve further attention in the future.

In general, we were pleased with this second draft of the Mission Plan, and urge DOE to continue interacting with the states in this planning stage of the program. Attached is a list of our specific comments on the Mission Plan, submitted for your consideration. We look forward to receiving updates of the Mission Plan when they become available.

Sincerely,

Robert M. Hallisey, Director
Radiation Control Program.

RMH/MG/bb

COMMENTS ON THE
"MISSION PLAN FOR THE CIVILIAN
RADIOACTIVE WASTE MANAGEMENT PROGRAM"
APRIL 1984 DRAFT

1. The two-phase approach for the first geologic repository is logical and appears to provide for waste acceptance by 1998. Massachusetts is in agreement with this federal objective.

2. The long-term time frame for construction and operation of the second repository appears to be very realistic and attainable.

3. Massachusetts is pleased to see a more explicit role for public participation in the development of a Monitored Retrievable Storage facility.

4. The description of transportation issues and plans was much improved, however an expanded discussion of emergency response activities might enhance the ultimate public acceptance of the program.

5. Destructive testing of transportation waste casks should be considered for inclusion in the schedules and the budget.

6. In view of the overall revenue surplus vs. costs of disposal and storage services, DOE might wish to consider continued study of alternatives to the Phase I decisions, i.e., as technological knowledge develops, alternatives might be indicated which would continue to keep states involved.

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Bailus Walker, Jr., Ph.D., M.P.H.
Commissioner

Seventh Floor

October 29, 1984

Dr. Sally Mann, Manager
Crystalline Repository Project
Department of Energy
Chicago Operations Office
9800 South Cass Office
Argonne, Illinois 60439

Dear Dr. Mann:

This letter provides comments of the Commonwealth of Massachusetts on the August 1984 draft of the Region-to-Area Screening Methodology. The draft report has been reviewed extensively by our in-State project team. In general we are pleased with the way OCRD has responded to the previous workshop comments including the scaling of the variables, the level of detail presented, and some explanation of OCRD position on various decisions.

However, we continue to be concerned about two serious omissions in the screening program. The first of these is the fact that the transportation variable has been dropped from immediate consideration in the process. Once again, we feel that transportation in terms of site accessibility must be included, it is clear that the most desirable of repository sites is of little use if it is distant from rail and truck routes. While we recognize that arbitrary assignment of distances to the regional variable scale is difficult since many other factors are involved, we feel it should be reinstated. Data on transportation routes is available and should be utilized at the regional phase.

The second major concern we have is the elimination of the concept of a base case set of weights. We feel this would be a good way to illustrate the process and how it will be applied to a representative region. It is not clear who is going to make the final weighting decisions. It would be useful to Massachusetts to have a base case set of weights prior to participation in the weighting workshop.

Thus far throughout the screening process we have sought to apply the best scientific and most objective methodology for site selection. We must make sure that this continues to be the case. It is possible that the assignment of weights to the variables at this stage could result in the ultimate selection of areas based on something other than scientific data, that is on weighting judgements. For this reason we would like to see a base case screening done with an unweighted application of variables as well as with a weighted set variables.

Another generic concern is that of utilizing local geological reports and maps. There are many such maps which have been developed at the State and local level. Certainly they should be looked at when evaluating crystalline rock areas. The quality of these papers varies greatly however, and care must be taken in the amount of weight these papers carry.

In terms of site selection in crystalline rock bodies, it is unclear if decisions will be made by DOE on the need for diversity among the selected rock bodies. Is there an intent to have a diversity of geological and geohydrologic setings and originality among the selected crystalline rock bodies?

We would also like to reinforce some of the major points presented in the states concensus report.

1. The intent to review qualitative/descriptive literature to possibly exclude candidate areas after they have been found favorable needs clarification;

2. Screening results should be released based on equally weighted or unweighted application of variables.

Finally, since sand and gravel are not considered as an important resource for Massachusetts, we would like to take this opportunity to submit our list of 180 peat lands, which are one (1) mile-square or greater. And submit our definition of the relation of peat and groundwater.

Since peat accumulates in depressions and on gently sloping areas that are poorly drained or where water collects and stands permanently, peatlands serve both as a groundwater discharge or a groundwater recharge. Discharge or recharge, depends on regional geology and the time of the year.

There are 180 wetlands within the Commonwealth of Massachusetts averaging 952 acres in size for a total of 171,300 acres. If only those peatlands that are greater than a square-mile are included, this represents 3.25 percent of the total area of the Commonwealth. A list of these wetlands is attached.

We hope our comments and concerns will be taken under consideration, and we look forward to receiving the final version of the Region-to-Area Screening Methodology.

Sincerely,

Robert M. Hallisey, Director
Radiation Control Program

RMH/bb

The Commonwealth of Massachusetts
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Department of Public Health
150 Tremont Street
Boston 02111 Tel: 727-6214

Bailus Walker, Jr., Ph.D., M.P.H.
COMMISSIONER Seventh Floor

April 5, 1985

Dr. Sally Mann, Manager
Crystalline Repository Project
Department of Energy
Chicago Operation Office
9800 South Cass Avenue
Argonne Ill. 60439

Dear Dr. Mann:

In accordance with your letter of December 10, 1984, the Commonwealth of Massachusetts is submitting the following comments for your consideration relative to the revised draft Regional Characterization Report (RCR's) both geological and environmental.

As set forth in your correspondence of January 23, 1985 pertaining to State Wildlife Lands, we have no strong objections to your proposed treatment of these lands for initial screening purposes. We recognize that both size and ownership/use elements will be considered for possible disqualification action. However, your caveat relative to a "case by case evaluation, as appropriate," during the Area phase meets with our concurrence.

A review of the ownership status of wildlife management lands and sanctuaries has confirmed that the areas set forth in Appendix B of the RCR are owned by the Commonwealth of Massachusetts. However, two areas listed do not fall in the less than 320 acre classification. West Meadows and Watatic Mounting are both jointly owned by Fish and Wildlife and Forests and Parks and their joint areas are greater than 320 acres, these areas are combined. One exception, however, is Knightvile Wildlife management area, it is owned by the Army Corps of Engineers.

Included in our comments of October 29, 1984, was a reference to the extensive peat deposit in Massachusetts. Under a prior grant from the Department of Energy (DOE), these potentially valuable areas were mapped and qualified. A copy of the DOE report is submitted for your general information and possible future guidance. We do recognize that these areas may have been included with your original wetlands estimate. The point we wish to reemphasize is that peat bogs serve both as discharge and charging elements for groundwater resources in the Commonwealth, and as such, are vital to future water supplies.

Those areas of high population density have been clearly defined in the RCR. However, we must point out that the seasonal fluctations due to the diversity of vacation and recreation options in Massachusetts create wide swings in population for short periods of time. For example, in the Western part of the Commonwealth, skiing in the winter and world famous music festivals in the summer contribute greatly to this situation. Therefore, if required, during the Area evaluation phase, this element will require intensive study and close evaluation.

This is probably one of the best and most comphrensive regional geological reports that we have seen. We have made several geological comments for your consideration.

A. The islands off the southern coast of Massachusetts should be included. This is especially true of the Elizabethian Islands which are virtually uninhabited and are composed of Dedham Granodiorite.

B. There are more and probably better references for specific areas than Algermissen with regards to ground acceleration during seismic events. Namely, Bernreuter, DL and others "Seismic Hazard Characterization of the Eastern U.S." NUREG/CR-3756.

C. There still is a discrepancy between the definition of crystalline rock bodies and the representation on the accompanying maps. There exists a number of crystalline rock bodies larger than the minimun required even outside of the Berkshire Wassif, which are not included in the narrative nor are they represented on the final version of the map.

Should you have any questions, please do not hestitate to contact us.

Sincerely,

Robert M. Hallisey, Director
Radiation Control Program.

RMH/bb

The Commonwealth of Massachusetts
Executive Office of Human Services
Department of Public Health
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Bailus Walker, Jr., Ph.D., M.P.H.
COMMISSIONER Seventh Floor

April 15, 1986

Dr. Sally Mann, Project Director
Crystalline Rock Project Office
U.S. Department of Energy
Chicago Operations Office
9800 South Cass Ave.
Argonne, Illinois 60439

RE: "Comments - Draft ARR"

Dear Dr. Mann:

Massachusetts appreciates the opportunity to reveiw and comment on the draft Area Recommendation Report for the Crystalline Repository Project. While the draft ARR eliminates Massachusetts from consideration to host a repository, the report identifies three sites in New England for further study.

Our review efforts focus on the issues of transportation and the weighting process. In addition, we address issues we feel would be beneficial to the final Area Recommendation Report.

We have enclosed our comments for your consideration. As a corridor state, we look forward to participating in the development and implementation of an integrated transportation system which will insure the protection of the public health and safety of the citizens of the Commonwealth of Massachusetts.

Sincerely,

Robert M. Hallisey, Director
Radiation Control Program.

RMH/DY/bb

COMMENTS ON THE DRAFT AREA RECOMMENDATION REPORT BY THE MASSACHUSETTS CRYSTALLINE REPOSITORY PROJECT STAFF

Massachusetts has several concerns about the preliminary decisions made in the Draft ARR. First, and most importantly, are the potential health and safety effects of transporting high-level waste and spent fuel on our highways and/or railroads. Secondly, the accuracy and reliability of the weighting process is questionable. These two overall issues in conjunction with specific concerns with the ARR itself, are the subject of the following comments.

TRANSPORTATION

Throughout the development of the crystalline repository screening methodology process, Massachusetts supported the inclusion of a transportation screening variable. The Department of Energy (DOE) has chosen to exclude tranportation impacts from the region-to-area screening phase. However, Massachusetts still advocates recognition of the realities of the transportation issues at this time.

Inclusion of transportation considerations in the final ARR should address several areas of concern. There should be consideration of factors which may be unique to New England, such as:

- o traffic congestion
- o high population areas
- o physical condition of the roadways and railbeds
- o seasonal water conditions.

If any northern New England location is finally selected as a site for a high-level nuclear waste repository, considerable hazardous traffic will be generated through heavily populated Massachusetts areas. Major interstate highways and railroads all funnel through urban areas. The Lowell, Lawrence, Haverhill, Newburyport corridor would be an obvious zone of heavy impact but population throughout the Commonwealth would be affected.

In February 1985, R.E. Philpott of DOE provided a tabulation of annual shipments of wastes to originate at each reactor site (does not include military waste shipments). The annual total shipments were 830 if by rail or 6405 if by truck. In his tabulation, only 39 by rail or 301 by truck originated in Massachusetts or the 3 northern New England states. If a southeastern or north central site is selected we need concern ourselves only with the latter two, relatively small numbers. If a northern New England site is selected, shipments through Massachusetts might be as high as 671 per year by rail or more than 5,000 per year by truck during peak years. This would be a serious health and safety hazard and an unacceptable burden for the population of a thickly settled state like Massachusetts.

DOE has given little indication of its standing on the following issues which are of great interest to Massachusetts:

- o emergency response plans
- o liability
- o general routing requirements
- o federal-state interaction
- o public awareness and education efforts
- o prenotification of shipments
- o transportation regulations and their implementation and enforcement.

It is recognized that these latter issues are somewhat premature for the second repository and corridor states, but they are being addressed by the first repository states and it is assumed that the same general standards would apply at both stages. At least a general summary of DOE's current position and/or future plans for addressing these issues would be beneficial to the final ARR.

If a site in New Hampshire or Maine were ultimately chosen for a second repository, Massachusetts would be subject to the potential health and safety impacts resulting from the transport of high-level waste and spent fuel shipped from up to 45 states (including our own) over our roads and railways on the way to a northern site.

Massachusetts feels strongly that all states, and particularly heavily travelled corridor states should be closely involved in the development and ultimate implementation of any DOE and Department of Transportation (DOT) waste transportation plans. Especially important to Massachusetts would be some immediate indication of DOE's intention for emergency response planning in the event of an accident on roads or railways. Specific concerns in this area include:

- o expected time frame for development of emergency response plans
- o training of state personnel
- o interaction of federal and state agencies
- o supplemental funding for state emergency response budgets
- o plans for response to rail accident in an area not having vehicular access
- o public information activities
- o adequacy of provisions for security of safe shipments.

All the above transportation issues should be of considerable importance in determining the likely candidate areas for a site.

THE WEIGHTING PROCESS

It is clear that the equally weighted composite scores as shown on the map NE3B do not delineate any areas within Massachusetts that are of the highest favorability. However, many of the rock bodies within the state fall into the next lower category. This is especially true for Cape Cod. Only very few sections have a rating of less than three. It must be said that reading the maps was not easy and the difference in ratings could have been clearer by using colors which are less like each other.

The weighting of the variables is described in detail. Obviously, some variables are more important than others in determining the safety of the deposit. What was not made clear is the importance that the various groups were to play in the weighting process. Nine groups were formed based on the similarity of their views on the relative importance of the variables. Since all the variables are either geologic or environmental in nature the qualifications of the people ranking these should be in those fields. But we are never told what the qualifications of the participants are. Were there people present who did not have any background in either of these two areas? Obviously, the states subgroup 2 was composed of geologists for they put most of the emphasis on faulting and seismicity. In other groups it is not clear. Were the two specialties equally represented? We do not know. We hear that the groups were formed by cluster analysis. Cluster analysis will form groups even if there is little affinity of one individual's preferences to those of another. Cluster analysis has to form groups. We are not told what the degree of association had to be in order for an individual to be in a specific group. We do know that one group was formed by individuals who had low affinities to each other.

Moreover, the groups are not equal in size. The CRP group had 46 individuals in five groups, the states had 37 participants in four groups. Therefore, in some groups an individual's choice was more important than in another group. From having been to the weighting workshop, I do know that the variance of each group fluctuated drastically. In one group the mean score for a particular variable may show the consensus of the group, in another group the mean score may not be the concensus of opinion but rather be a mathematical artifact. In fact, not one member of the group may have that opinion, but it may be numerically half way between two poles of opinions.

What is most disturbing is the fact that the individual group's ratings were used as such. The decision was made that those rock bodies which were rated more favorably by seven out of the nine groups in Phase A were included in the consideration. This number was chosen so that roughly 20 rock bodies would remain. There seems to be a flaw in this type of logic. It works fine if nine out of the nine groups agree in the classification. It is in those in which there are eight or seven that agree that a different favorability may be reached than by the method chosen. For instance, in Phase A not one of the nine groups rated variable one - the rock mass - as the most important. Four groups chose variable two - major ground water discharge zone - as the most important. So obviously, for those four groups ground water discharge will get a higher weight. If, on the other hand we use the composite score for all nine groups then not ground water but rock mass is the more important variable. It's composite weight for all nine groups is 1308.3 whereas that of ground water is only 1206. A small difference but almost assuredly, significant.

Take another example, suppose that a rock body is covered with a considerable number of wetlands. Suppose that the weighted variability of this rock body based on 15 variables (not including variable 14 - the wetlands) is such that seven out of nine groups rate it above the benchmark. Now add the wetland variable. Because one group considers

it the most important variable, the site will drop from seven out of nine groups to six out of nine group favorability and therefore out of consideration. However, as a whole all of the groups rated wetlands very low giving it a composite score of only 358.4. So if a composite weight of all the nine groups had been used this rock body would still be rated favorably. So I would suggest that the ratings be redone to reflect the composite weights rather than letting each groups' weights be used.

Using the sixteen variables, in New England these were the most favorable areas (Tables 3-4a, 3-4b):

CRP

1.	4/4.8,	2/4.6,	3/4.6,	1/4.5,	N5/4.3,	5/4.3,	N6/4.3,	N14/4.3.
2.	4/4.6,	2/4.3,	3/4.3,	1/4.2,	N5/4.3,	5/4.3,		
3.	4/4.6,	2/4.4,	3/4.4,		N5/4.5,	5/4.4,		N10/4.4.
4.	4/4.4,	2/4.2,		1/4.2,	N5/4.4,	5/4.3.		
5.	4/4.4,	2/4.3,	3/4.2,	1/4.2,	N5/4.5,	5/4.2.		

States

1.	4/3.6,			N5/3.9,	5/3.3.	
2.	4/4.5,	2/4.2,	3/4.2.			
3.	4/3.9,		1/3.9,	N5/4.4,	5/3.9.	
4.	4/4.3,			N5/4.4.		

Now according to table 3-5 area NE-N5 (the Chain Lakes Massif) was rated favorably by all nine subgroups of weights but the states subgroup 2 did not rate NE-N5 above the benchmark of favorability of 4.2. So it was chosen by only eight of the groups. Similarly NE-5, the Cardigan Pluton, was not rated favorably by eight out of nine but only by seven out of nine.

Likewise, NE-2 the Bottle Lake Complex rather than being rated favorably by seven out of nine was rated favorably by only six out of nine and therefore drops out of contention.

If this is correct (and Table 3-5 is wrong) then <u>three</u> areas are favorable in New England.

To show the extreme sensitivity of the variable weights, Phase B was initiated. This phase changed the scales for three variables, namely seismicity, rock mass extent, and proximity to highly populated areas. These scale changes were made on account of comments by the States and input from DOE. Then why are they not utilized? We are given no information of why Phase B was not used. We can only surmise that to go to seven out of nine subgroup favorability yielded too many rock bodies. If Phase B were indeed used then, in New England, NE-1 Katahdin Complex, NE-2 Bottle Lake Complex, NE-3 Deblois Complex, NE-N14 Green Mountain Massif would have to be added to the list. NE-1 the Katahdin Complex jumps from less than seven out of nine favorably to nine out of nine. However, since the ranking on which Table 3-6 was based is not presented, we cannot judge the table's veracity. The statement "The DOE believes .... the candidate areas identified on the

Phase A summary composite map remain as the more favorable preliminary candidate areas as defined by the Phase B summary composite maps" is not backed by any rational arguement. In fact, it is not backed at all.

REGIONAL EFFECTS

The effects of a high level waste repository located in New England impact not only the host state, but every other state in the region as well. The Northeast is a geographically compact area and one where the selection of a repository within the region would impact on states other than first the host state. Such regional impacts include the following:

- o The effects of a repository on the major industry of tourism in the area. New Hampshire and Maine are prime vacation areas.
- o The reluctance of tourists to visit areas near the repository would have a ripple effect on the tourism industry for the whole of New England.
- o The fluctation of seasonal populations has obviously not been considered at this stage but would be substantial during the vacation months.

Regional economic impacts such as these should be considered in the next stages of repository screening.

States and Indian tribes should have a chance to review the final documents before they are released to the public and become an Official Document for the Repository program. This is to insure that comments have been digested, by the DOE and its Battelle staff, thus allowing for the comments to be applied respectfully to their appropriate geological, environmental and socioeconomic variables. This would minimize the prospect of DOE or its subcontractor, Battelle from typifying answers or comments into generalized categories with no application or link to specific factors or variables.

There is reason for concern regarding the lack of attention paid to the states comments during the screening methodology workshops, which asked for the alignment of some variables to be changed.

There is a favorable numerical advantage given to the DOE's application of weights over the state's application of weights, when the subgroups were not numerically equal.

It should be noted that Phases C & D were only applied in the North Central Region. This could be due to the lack of documented geological data available Northeast and Southeast regions. This lack of information should have been weighted as "not equally applicable" to the North central region over the Northeast or Southeast regions.

It appears that use of Phases C & D in the selection of areas in the North central region lends itself to more detailed graphics of the

North central region over the Northeast and Southeast regions. This could be a significant factor to state teams in the Northeast and Southeast regions in preparing their responses to the APR.

It should be also be pointed out that Preliminary Candidate Area NE-2, which is approximately 27 miles west of the Maine/New Brunswick Canadian border is under consideration and yet NE-N5 is not because it is approximately 13 miles east of the Canadian border. If NE-N5 is a better overall location, which it seems utilizing the four steps of candidate areas screening, then why was it eliminated from consideration?

SPECIFIC DOCUMENT COMMENTS

Detailed review of the subject document reveals numerous other problems, both procedural and factual, that cast further doubt on the selection of New England candidate areas:

page section
1-1 "footnote" Comment: This definition, ipso facto, should eliminate at least two of the three New England Candidate areas. Technically they may not be eligible for automatic disqualification under DOE/Battelle criteria, but they certainly have: "known characteristics which provide sufficient basis for deferral." See subsequent comments for details.

1-2 1.2 Comment: In the case of New England, the CRP did not succeed in "identifying bodies of crystalline rock having the highest potential for qualifying as repository sites." If our geological staff had been asked to select empirically the 10 highest potential New England sites, only one of the three sites selected by CRP would have been among them.

1-5 1.2.1.1 Comment: Rock mass size" would seem to disqualify the Sebago Lake and Cardigan rock bodies because they are thin when compared with most of the rock bodies considered. In CRP Regional Geologic Characterization Reports 32 rock body thickness were found, distributed by thickness as follows:

More than 10 km	1
5 - 10	5
3 - 5	10
2 - 3	7
1 - 2	9

Cardigan listed at 1.5 km had only 3 rock bodies thinner including Sebago. Sebago had none thinner at its listed thickness of 1.0. It is likely that the average thickness of rock bodies without listed thickness was as great or greater than that of the 32 broken down above.

2.3 2-2 Step - 2 Comment: There must have been a rather subjective "spectrum of viewpoints" regarding "relative importance of variables" to yield Sebago Lake in the top 20 out of 235 eligible during the selection process.

page section
2-8 2.3.1 Comment: Based on rock body selection in New England the weighting workshop process was flawed.

2-10 2.3.2 Comment: There were five CRP sub-groups and only four State subgroups. Were the State results considered at 50% of the total weighting or as only 4/9ths?

2-11
to 2-20 2.4 Comment: Perusal of Tables 2-3 through 2-9 reveal lower stress placed by CRP sub-groups on variables such as population density, wetlands, surface water body areas, and proximity to highly populated areas, when compared with State subgroups. Could this difference in viewpoint have been in order to achieve "regionality" as mentioned on page 2-20?

3-7 Table 3-2 Comment: It is noted that "State-Protected Lands" disqualified 30.17% of northeastern rock bodies compared with 2.53% of north central and 0.95% in the southeast. The Table demonstrates that state land policy saved at least one northeastern state from selection of candidate areas within its borders.

3-13 Table 3-4a
to 3-26 to 3-4 Comment: After the various permutations and perturbations of the data, The New England rock bodies that moved forward were the same four that orginally appeared on the candidate lists of all 5 CRP weighting sub-groups and that none of the New England areas not listed for all 5 sub-groups in Table 3-4a moved forward. It is also noted that the 5 CRP groups rated Sebago Lake as best in the northeast (ave. 7.2) while Chain Lake, rated highest in New England by State groups was struck down on the basis of geographic proximity to Canada.

3-41 Table 3-10 Comment: Two of these Preliminary Candidate Areas appeared on only three of the nine original sub-group weighting lists (Tables 3-4a and 3-4b). The subsequent "phases" must have massaged at least these two PCA's with considerable vigor.

3-355/356 3.2.2.1.1.2 Comment: The final paragraph on p. 355 states that plutons are "thought to be thicker" in northern Vermont and northern Maine. This argues, per se, against selection of Cardigan and Sebago Lake.

3-359 3.2.2.1.1.3 Comment: When dealing with phenomena with recurrences as intervals "on the order of hundred to thousands of years" (or perhaps tens of thousands of years) all formulations methodologies, and working hypotheses are highy speculative and of very limited value.

3-363 3.2.2.1.1.4 Comment: The statement that nonmetallic and nonstrategic resources are not unique is a very sweeping one and is not universally correct.

page section
3-363/364
365 3.2.2.1.1.5 Comment: This section fails to note the intimate relationships in New England between groundwater and aquifers with lakes, streams, and bogs. The discharge-recharge interactions are barely hinted at. It does note correctly that groundwater flow generally replicates topography. It fails to note that in New England one finds streams, lakes and bogs in most topographic lows and that such surface water bodies are usually at or below the water table and are frequently groundwater, as well as surface water, fed.

3-366 3.2.2.1.2.3 Comment: This last sentence says the Portsmouth-Dover-Rochester population centers extend into Massachusetts. According to the second sentence (and in reality) they also extend into Maine. In addition, CRP Population Density maps show that while the Nashua population center may be entirely within New Hampshire, it also has a common border (contiguous with) the Lowell-Lawrence, Massachusetts center. From the center of Nashua to the center of Lowell is only 10 miles.

3-366/367 3.2.2.1.2.4 Comment: This section maintains critical habitat only for the Robbins cinquefoil. It neglects to mention the critical habitat designation for the Plymouth Red-Bellied Turtle.

3-369 3.2.2.2 Comment: If our geologists had been asked to select 10 New England Candidate areas, Bottle Lake would probably have been one of those selected empirically.

3-383 3.2.2.2.4 Comment: The last paragraph of this section may be true, but no data are presented about thoroughness of previous prospecting.

3-385/ 3.2.2.2.5
387/389 3.2.2.2.6 Comment: Page 3-385 repeats the last paragraph of 3-383, then 3-387 repeats the last four paragraphs of 3-385. These sections oversimplify ground/surface water interactions per our comment on 3.2.2.1.1.5.

3-389 3.2.2.2.6 Comment: Human, industrial, and agricultural water use are better terminology for eastern Maine than "irrigation."

3-399 3.2.2.3.1 Comment: A sheet 0.62 miles thick would seem to offer an insufficient safety margin for unmonitored storage over several thousand years.

3-401 Fig. 3-97 Comment: Section A - A' is apparently considered relevant even though it is about 15 miles east of the area. The presence of Portland about the same distance away should be relevant enough to disqualify this candidate area.

3-404 3.2.2.3.1. Comment: The stated thickness of the rock body makes it a very poor choice for a high level waste repository.

page section
3-404 3.2.2.3.2 Comment: New England "two-mica" granites are of some interest as a possible uranium source, and are of concern as a source of environmental radon.

3-406 3.2.2.3.2 Comment: Faults outside the proposed candidate area may affect it by offering attractive pathways for groundwater migration. Some of the identified faults may extend further into the candidate area than presently suspected.

3-407 3.2.2.3.2 Comment: Foliation and well-developed joints do not argue well for the suitability of the Sebago Lake "batholith" candidate area.

3-412 3.2.2.3.5 Comment: Seventy-five percent of the surface water drains toward Portland and other Maine coastal cities. The importance of Sebago Lake, on the candidate area boundary, as a municipal water supply is not discussed.

3-413 3.2.2.3.6 Comment: The importance of Poland spring water and its relation to the candidate area is not discussed. The historical importance of the bottling plant is noted on p. 3-429. Poland Spring water is sold throughout the east, and in some markets is not far below Perrier water at retail. The comment made for section 3.2.2.1.1.5 also applies here.

3-415/416
417 Figs. 103a Comment: These maps suggest the major fracture zones of hydrologic importance cross the candidate area.

3-428 3.2.2.3.9 Comment: A wild and scenic river traversing the preliminary candidate area is another reason Sebago Lake is a poor selection.

3-429 3.2.2.3.10 Comment: Poland Springs is noted as of "historical" significance within the preliminary candidate area boundary.

3-429/430 3.2.2.3.11 Comment: The number of populated areas within 10 miles should disqualify the candidate area. Funds should not be expended investigating an area that should have been selected out in the first place.

3-430 3.2.2.3.11 Comment: These data indicate that 23,870 persons live within the candidate area year round! Seasonal residents number more than that in all probability. Surely, this is an incorrectly selected candidate area.

3-432 3.2.2.3.15 Comment: The indicated average thickness of the host rock appears to be insufficient for the intended use and proposed operational parameters.

3-433,434 3.2.2.3.15 Comment: No analysis or evaluation is provided for Poland Spring water. It is a groundwater resource currently being extracted.

page section
3-434 3.2.2.3.15 Comment: Further study of this candidate area should not be undertaken and it should be deleted at once from the list of candidates.

3-435/439 3.2.2.4.1 Comment: This host rock is of marginal thickness for consideration.

3-441 3.2.2.4.2 Comment: Two prominent foliations and two sets of prominent joints make the proposed host rock a candidate for prohibitive interaction with groundwater.

3-444 3.2.2.4.5 Comment: The p.c.a. lies in the western portion of the Merrimack River drainage basin. It drains to the sea through Nashua, Lowell, Lawrence, Haverhill, and Newburyport. The attendant risks are too great for this p.c.a. to be considered further.

3-448 Fig. 3-114 Comment: The high yield aquifers probably interact with both the Contoocook River and bedrock aquifers that extend into the p.c.a.

3-455 3.2.2.4.11 Comment: There appear to be approximately 3,625 year-round residents in the p.c.a. plus an unknown number of seasonal residents and tourists.

3-457 3.2.2.4.15 Comment: Host rock thickness is marginal for the type of repository operation proposed.

3-460 3.2.2.4.15 Comment: We feel the p.c.a. is not appropriate and should be deferred at this time.

3-645 3.3 Comment: If New England p.c.a.'s were selected to achieve "regionality" the wrong sites were selected for candidacy. One of the three (Bottle Lake) is rational. One (Cardigan) is borderline. The third (Sebago) is ridiculous and yet the selection process seemed to rate it highest in the northeast.

4-10/12 4.1.6. Comment: Cumulative impacts upon populations and their attendant water supply needs should have removed both Sebago Lake and Cardigan from further consideration.

5-5 5.4 Comment: Bottle Lake is only a potentially acceptable site but, on empirical evidence, it appears potentially better suited than Sebago Lake or Cardigan.

A-6/18 A.2 Comment: Either the process was flawed or it was not properly applied to rate Sebago Lake designation as a p.c.a.

A-19/26 A.3 Comment: Same comment. It is noted that in section A.3.21 on page A-23 Sebago Lake would be toward the "more adverse" end of the scale.

page | section
C-3 to C.4 &
C-7 C.5 Comment: Our analyses indicate selection of New England sites was dominated by consistently high ratings by CRP subgroups 1-5. For example compare these rankings.

	SUB GROUP										
	CRP						STATE				
Site	1	2	3	4	5	Ave.	6	7	8	9	Ave.
NE-2	11	16	19	22	10	15.6	-	21	-	-	-
NE-4	6	4	9	9	8	7.2	13	8	19	12	13.0
NE-5	25	18	21	15	19	19.6	22	-	20	-	-

The only one of the three sites averaging "on the board" by the state subgroups appears to be the poorest choice of the three, indicating a flawed process or a misunderstanding of the process to compound the apparently subjective ratings by CRP groups to achieve "regionality."

The Commonwealth of Massachusetts
Executive Office of Human Services
Department of Public Health
150 Tremont Street
Boston 02111 Tel: 727-6214

Bailus Walker, Jr., Ph.D., M.P.H.
Commissioner, Seventh Floor

October 23, 1986

J. Dexter Peach
Assistant Comptroller General
Resources, Community and
Economic Development Division
United States General Accouting Office
Washington, DC. 20548

Dear Mr. Peach:

Thank you for sending us copies of the draft report, Nuclear Waste: Institutional Relations Under The Nuclear Waste Policy Act of 1982. We appreciate the opportunity to review the draft and submit comments for your consideration in preparing the final report.

In general, we concur with the principal findings of the report, particularly those findings that pertain to the second repository states. We believe that more substantive participation by states and tribes in the decision-making process can serve to build confidence in the U.S. Department of Energy (DOE) and its management of the High-Level Waste (HLW) program.

Massachusetts has been invited to participate in various DOE meetings such as the screening methodology workshop and the transportation workshop in Atlanta. We felt our participation was important to provide input into program issues as well as gain a better understanding of the decision-making process. Although efforts surrounding the search for a second repository have been postponed, we feel DOE should continue to include states impacted by various aspects of the HLW program in its decision-making efforts.

Massachusetts has repeatedly voiced its concern over issues concerning the transportation of HLW. HLW will most likely pass through Massachusetts on its way to a repository in the west. Therefore we support the General Accounting Office's (GAO) recommendation that DOE provide [impacted] states and tribes access, at least on a trial basis, to all OCRWM coordinating group meetings. This idea was strongly urged in various working group sessions at the fall 1985 transportation workshop.

Massachusetts is not firmly convinced that a geologic repository can safely isolate nuclear waste from the environment for thousands of years without posing a hazard to the public health and safety of our citizens as well as to the environment. The employment of independent advisory groups to monitor site characterization and other program activities could lend more credibility to the HLW program as well as build confidence in DOE's ability to manage the program.

Finally, we feel DOE underestimated the opposition it would encounter from the second repository states upon release of the Draft Area Recommendation Report in January 1986. There is no doubt that the disposal of nuclear waste is a controversial issue and that DOE will encounter many conflicts in its attempts to reach the goals set forth by the Nuclear Waste Policy Act of 1982. At the transportation workshop in 1985, it was recommended DOE develop conflict resolution measures. Without a process for resolving conflicts, it is unlikely DOE will be able to complete negotiations for consultation and cooperative agreements. Therefore, we support the GAO recommendation that DOE adopt a strategy for negotiating incremental agreements with the states and tribes in an effort to build a foundation for resolving controversial issues.

Thank you for the opportunity to comment.

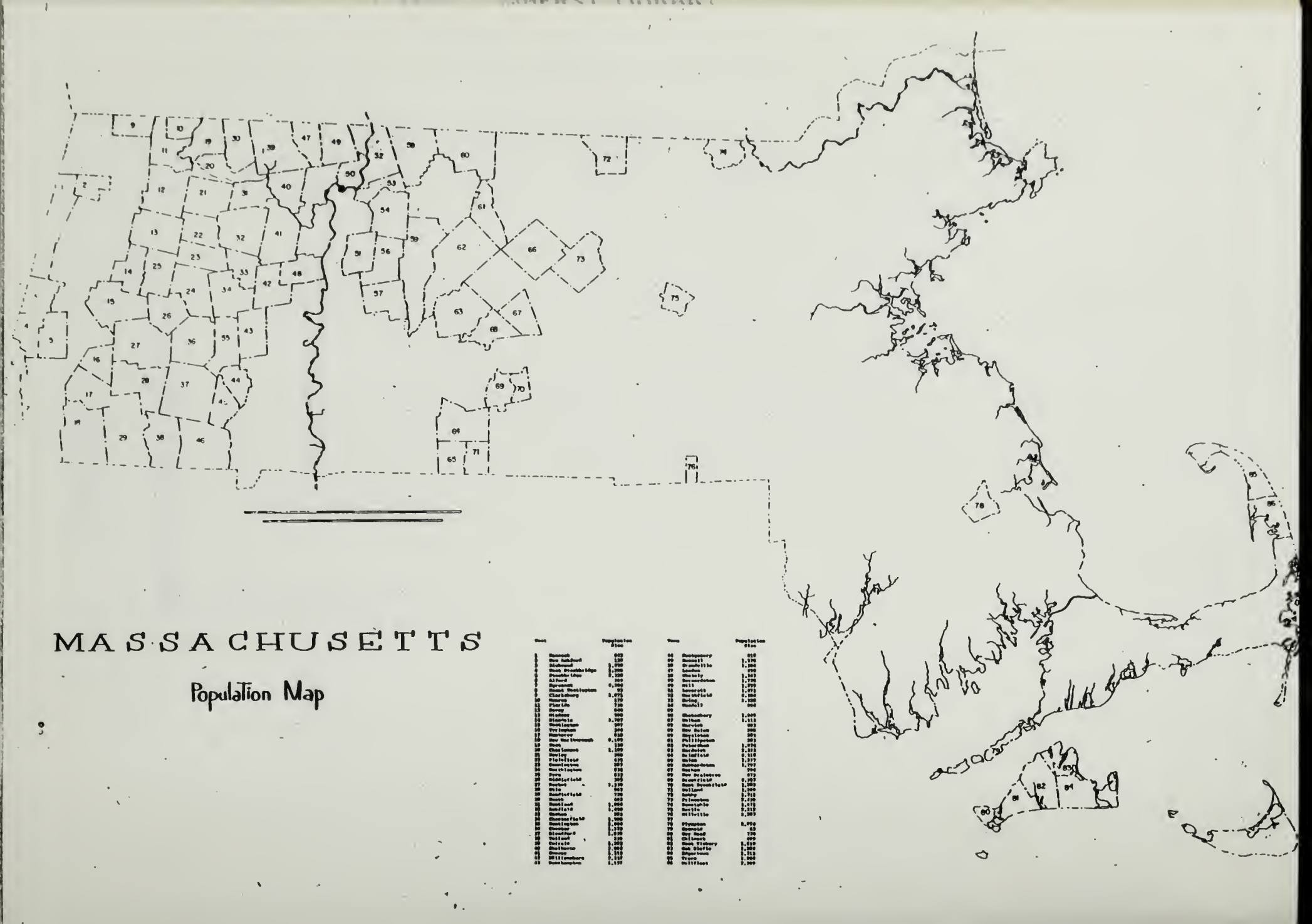
Sincerely,

Robert M. Hallisey, Director
Radiation Control Program

RMH/DY/bb

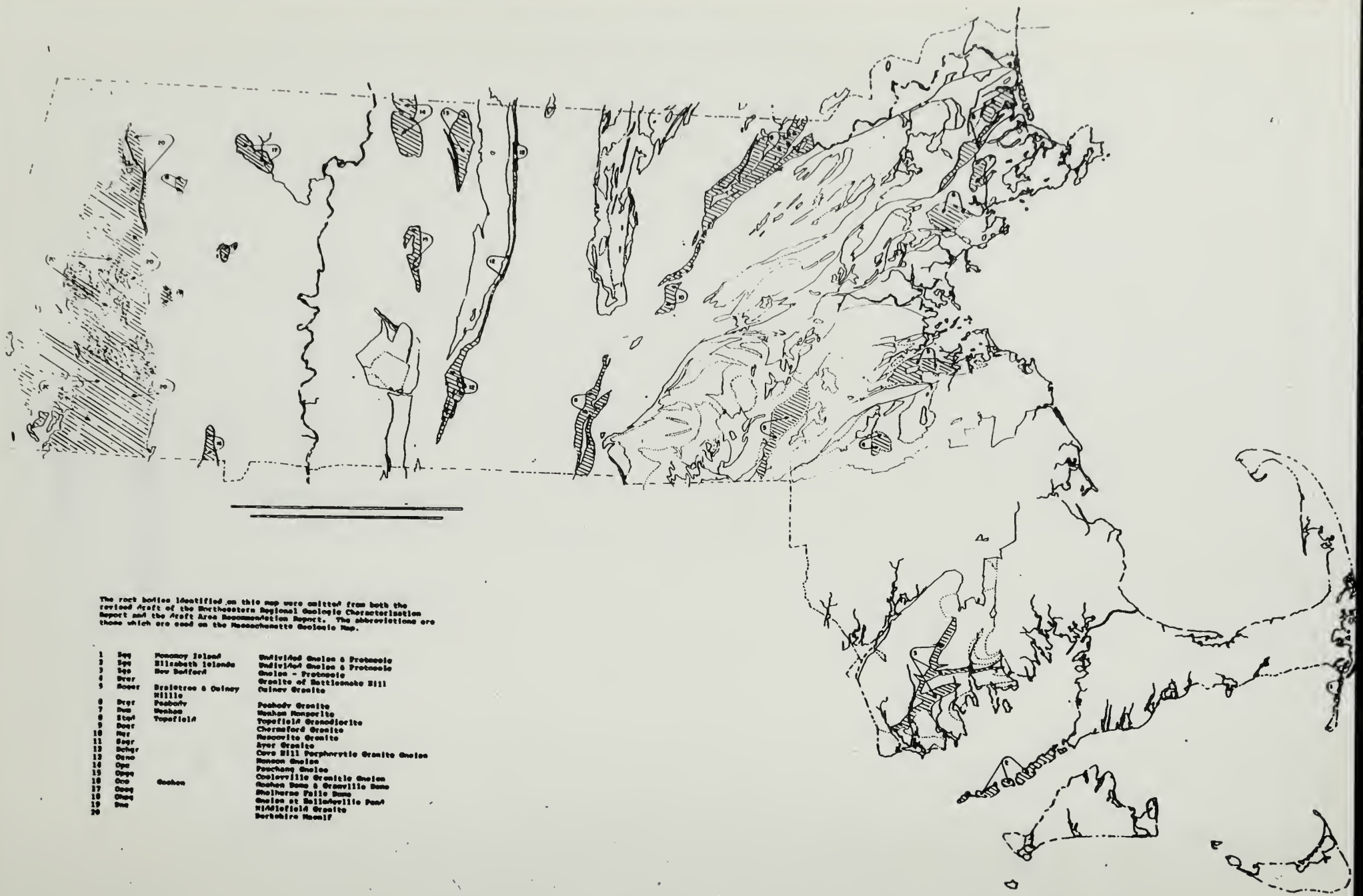
APPENDIX C

POPULATION MAP


MASSACHUSETTS
Population Map

APPENDIX D

CRYSTALLINE ROCK BODY MAP

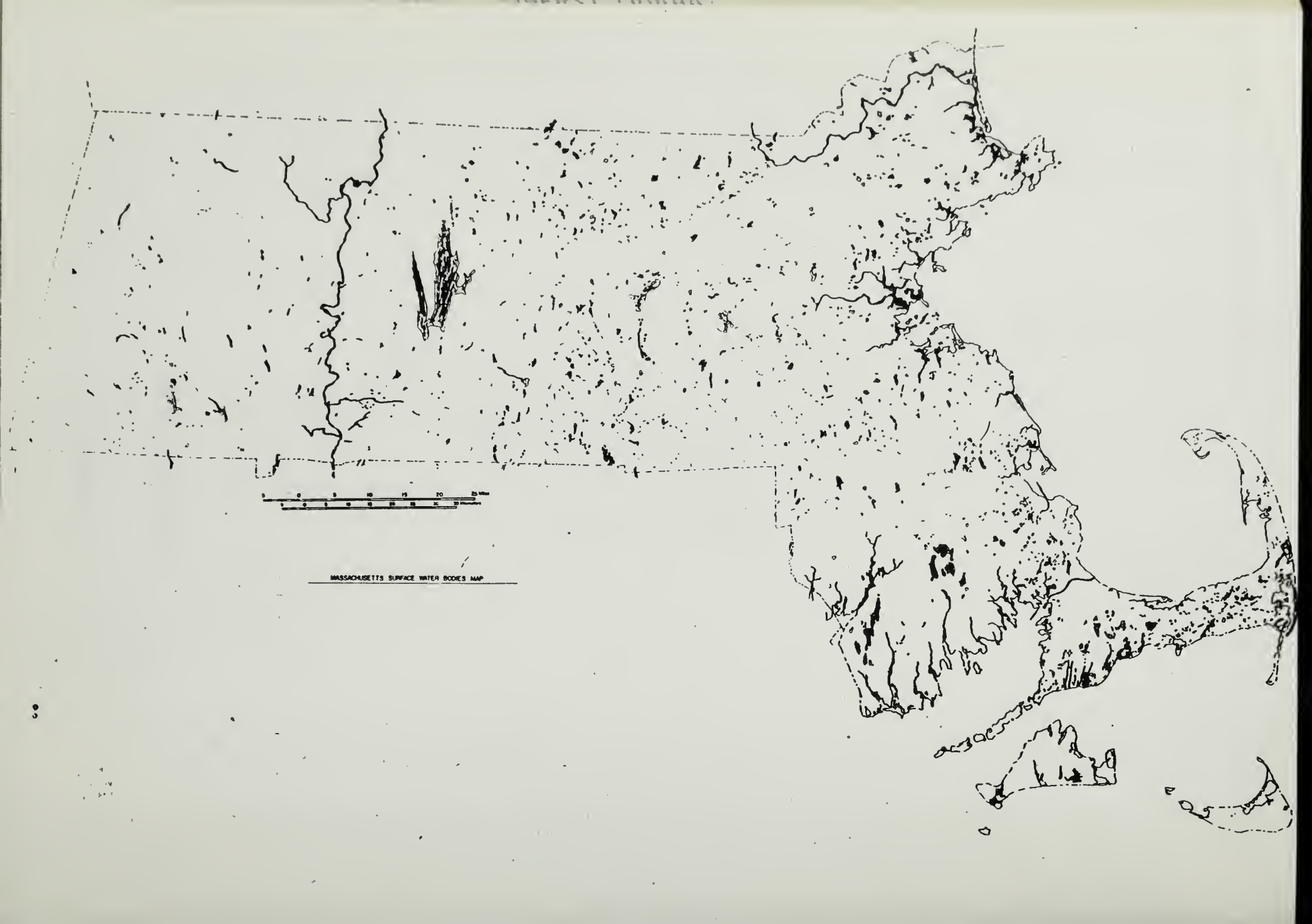


The rock bodies identified on this map were omitted from both the revised draft of the Northeastern Regional Geologic Characterization Report and the Draft Area Recommendation Report. The abbreviations are those which are used on the Massachusetts Geologic Map.

1	Ygn	Rosemary Island	Undivided Gneiss & Protoxole
2	Ygn	Elizabeth Islands	Undivided Gneiss & Protoxole
3	Ygn	New Bedford	Gneiss - Protoxole
4	Dtr		Granite of Rattlesnake Hill
5	Dqmr	Braintree & Quincy Hillis	Quincy Granite
6	Dpr	Peabody	Peabody Granite
7	Dmh	Nashua	Nashua Monzonite
8	Dtpf	Topsfield	Topsfield Granodiorite
9	Dcr		Chelmsford Granite
10	Dmr		Muscovite Granite
11	Dqr		Ayer Granite
12	Dchgr		Cove Hill Porphyritic Granite Gneiss
13	Dhg		Hanson Gneiss
14	Dpg		Peacham Gneiss
15	Dcg		Coolerville Granitic Gneiss
16	Dnh	Nashua	Nashua Dome & Granville Dome
17	Dmg		Shelburne Falls Dome
18	Dgg		Gneiss at Bellingville Pond
19			Middlefield Granite
20			Berkshire Massif

APPENDIX E

SURFACE WATER BODY MAP



MASSACHUSETTS SURFACE WATER BODIES MAP

APPENDIX F

SEISMICITY DATA

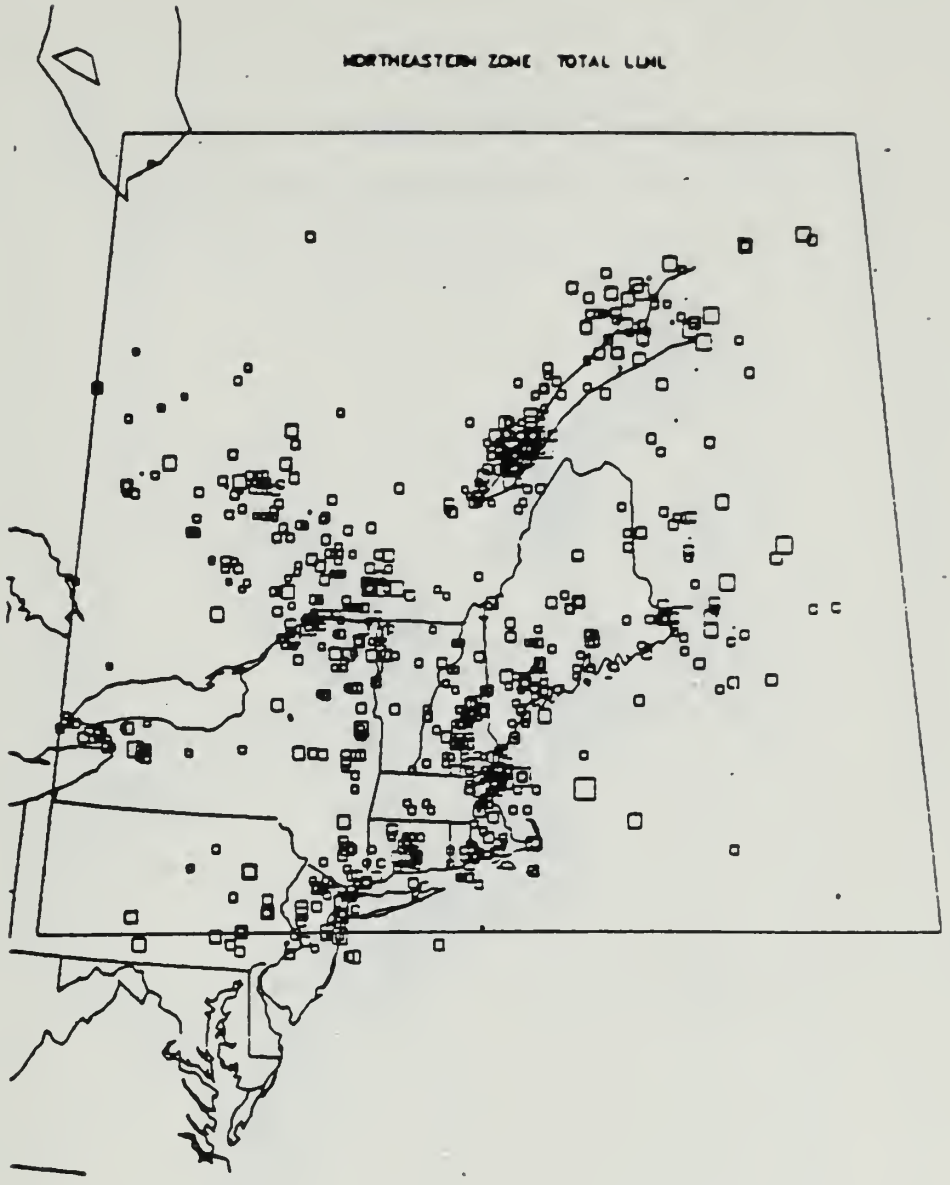


Fig. 3.4.3a. Location of the earthquakes since 1500 in the LLNL catalog for the region shown. The size of the plotted square is proportional to the magnitude of the plotted event.

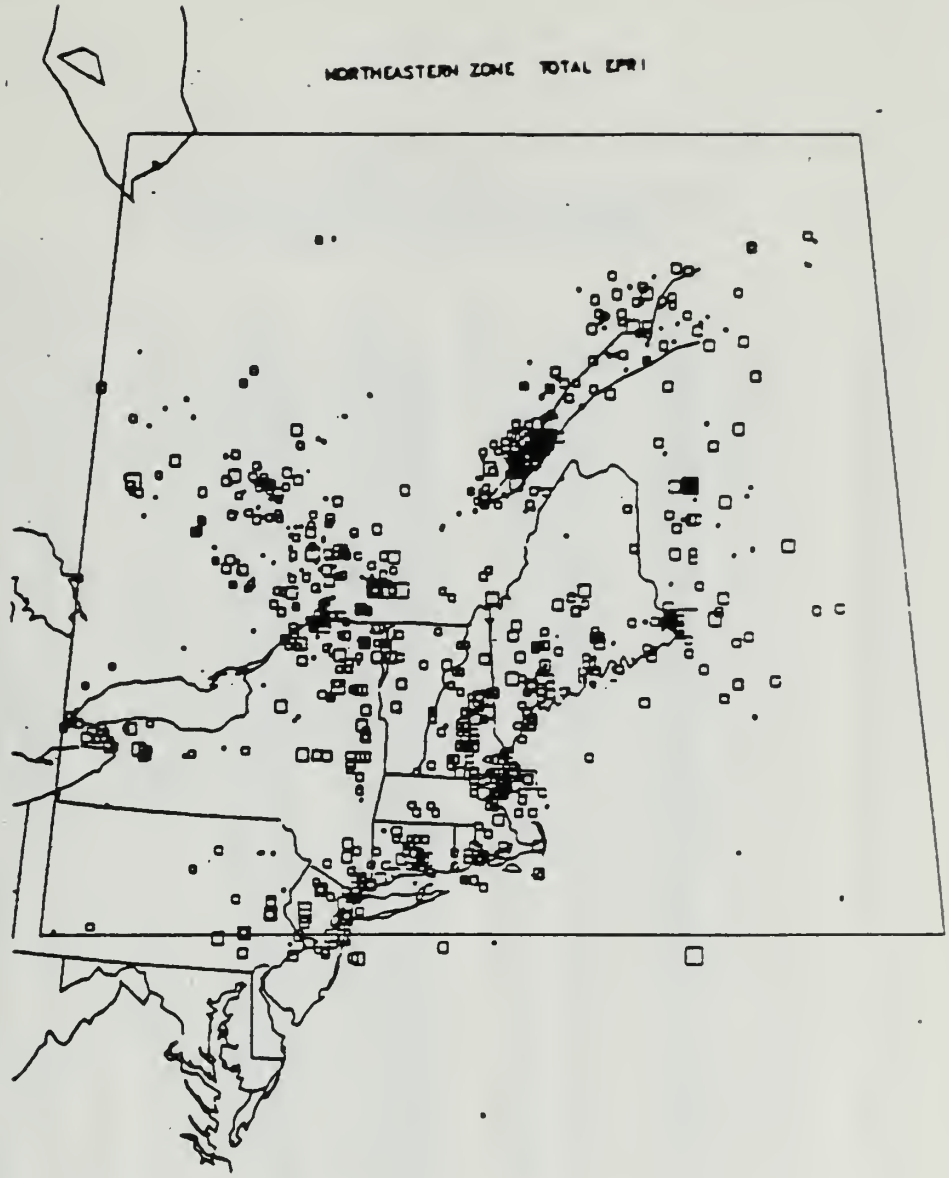


Fig. 3.4.3b. Location of the earthquakes since 1500 in the EPRI catalog (including clusters but only the preferred entries used) for the region shown. The size of the plotted square is proportional to the magnitude of the plotted event.

Table 3.4.1
Listing of the 150 Largest Earthquakes
in the LLNL Catalog since 1700

YEAR	MO	DY	HR	MN	SEC	LAT	LONG	INT	ML	MB	MS	FD	SOURCE
1812	2	7	9	45	0.0	36.50N	89.59W	11.5	0.0	7.40	8.2	0.	NUT
1811	12	16	8	15	0.0	36.00N	90.00W	11.0	0.0	7.20	8.0	0.	NUT
1812	1	23	15	0	0.0	36.29N	89.59W	10.5	0.0	7.10	7.8	0.	NUT
1886	9	1	2	51	0.0	32.90N	80.00W	10.0	0.0	0.00	0.0	0.	EQH
1925	3	1	2	19	0.0	47.70N	70.10W	9.0	0.0	6.60	0.0	0.	LLL
1928	11	1	4	12	49.0	27.00N	105.50W	0.0	0.0	6.30	0.0	0.	G-R
1870	10	20	16	25	0.0	47.40N	70.50W	9.0	0.0	0.00	0.0	0.	EQH
1895	10	31	11	8	0.0	37.00N	89.40W	9.0	0.0	6.20	0.0	0.	NUT
1935	11	1	6	3	0.0	46.80N	79.10W	7.0	0.0	6.20	5.9	0.	LLL
1755	11	18	10	29	0.0	42.50N	70.00W	4.0	0.0	6.00	0.0	0.	LLL
1843	1	5	2	45	0.0	35.50N	90.50W	8.0	0.0	6.00	0.0	0.	NUT
1891	9	27	4	55	0.0	38.29N	88.50W	7.0	0.0	5.80	0.0	0.	NUT
1931	8	16	11	40	21.0	30.60N	104.09W	8.0	0.0	5.80	6.4	0.	NUT
1944	9	5	4	38	0.0	44.90N	74.90W	8.0	0.0	5.80	5.6	0.	LLL
1732	9	16	16	0	0.0	45.50N	73.60W	8.0	0.0	0.00	0.0	0.	WES
1755	11	18	9	12	0.0	42.70N	70.30W	8.0	0.0	0.00	0.0	0.	WES
1791	12	7	1	0	0.0	47.40N	70.50W	8.0	0.0	0.00	0.0	0.	WES
1860	10	17	11	15	0.0	47.50N	70.10W	8.0	0.0	0.00	0.0	0.	WES
1882	10	22	22	15	0.0	33.59N	95.59W	8.0	0.0	5.50	0.0	0.	NUT
1897	5	31	18	58	0.0	37.30N	80.70W	8.0	0.0	0.00	0.0	0.	EUS
1906	5	26	15	0	0.0	47.29N	88.40W	8.0	0.0	3.60	0.0	0.	NUT
1906	5	26	15	0	0.0	47.30N	88.40W	8.0	0.0	0.00	0.0	0.	EQH
1924	9	30	8	52	0.0	47.60N	69.70W	8.0	5.5	0.00	0.0	0.	WES
1929	8	12	11	24	0.0	42.90N	78.40W	8.0	0.0	5.20	0.0	0.	LLL
1838	6	9	14	45	0.0	38.50N	89.00W	7.5	0.0	5.70	0.0	0.	NUT
1939	11	19	11	54	0.0	47.80N	70.00W	0.0	0.0	5.70	5.0	0.	LLL
1939	10	19	11	53	.0	47.80N	70.00W	6.0	0.0	5.60	0.0	0.	LLL
1945	7	26	10	32	15.0	34.50N	81.50W	5.0	0.0	5.60	0.0	0.	BOL
1974	3	27	16	10	56.3	38.55N	90.13W	3.0	0.0	5.60	0.0	0.	GS
1906	1	8	0	15	0.0	39.20N	96.50W	7.5	0.0	4.90	0.0	0.	NUT
1909	5	16	4	15	0.0	50.00N	105.00W	0.0	0.0	5.50	5.5	0.	CAN
1914	2	10	18	31	0.0	45.00N	76.90W	7.0	0.0	5.50	0.0	0.	EUS
1937	3	9	5	44	33.0	40.40N	84.19W	7.5	0.0	5.00	4.7	0.	NUT
1940	12	20	7	27	0.0	43.80N	71.30W	7.0	0.0	5.50	5.4	0.	LLL
1968	11	9	17	1	41.0	38.00N	88.50W	7.0	0.0	5.50	5.2	0.	NUT
1935	11	2	14	31	0.0	47.20N	78.20W	0.0	5.4	0.00	0.0	0.	WES
1940	12	24	14	33	0.0	43.80N	71.30W	7.0	0.0	5.40	5.4	0.	LLL
1944	4	9	12	44	0.0	49.90N	67.40W	0.0	5.4	0.00	0.0	0.	WES
1958	5	14	17	41	0.0	47.00N	76.60W	0.0	5.4	0.00	0.0	0.	WES
1857	10	8	10	0	0.0	38.70N	89.19W	7.0	0.0	5.30	0.0	0.	NUT
1865	8	17	15	0	0.0	36.50N	89.50W	7.0	0.0	5.30	0.0	0.	NUT
1875	6	18	13	43	0.0	40.20N	84.00W	7.0	0.0	5.30	0.0	0.	NUT
1953	1	24	9	58	0.0	49.10N	66.00W	0.0	5.3	0.00	0.0	0.	WES
1967	8	9	13	25	6.2	39.90N	104.70W	7.0	0.0	5.30	0.0	0.	USE
1967	9	30	22	39	0.0	49.50N	65.80W	0.0	0.0	5.30	0.0	0.	WES
1727	11	10	3	40	0.0	42.80N	70.80W	7.0	0.0	4.96	0.0	0.	LLL
1737	12	19	4	0	0.0	40.80N	74.00W	7.0	0.0	0.00	0.0	0.	WES
1774	2	21	19	0	0.0	37.20N	77.40W	7.0	0.0	0.00	0.0	0.	EQH
1816	9	9	0	0	0.0	45.50N	73.60W	7.0	0.0	0.00	0.0	0.	WES
1831	5	8	0	0	0.0	47.30N	70.50W	7.0	0.0	0.00	0.0	0.	WES
1831	7	14	0	0	0.0	47.60N	70.10W	7.0	0.0	0.00	0.0	0.	WES

Table 3.4.1 (Continued)

YEAR	MO	DY	HR	MN	SEC	LAT	LONG	INT	ML	MB	MS	FD	SOURCE
	CZ	LLNL	CAT										
1899	4	30	2	5	0.0	38.50N	87.00W	6.5	0.0	4.60	0.0	0.	NUT
1905	8	22	5	8	0.0	36.79N	89.59W	6.5	0.0	4.80	0.0	0.	NUT
1917	4	9	20	52	0.0	38.09N	90.19W	6.0	0.0	5.00	0.0	0.	NUT
1922	11	27	3	31	0.0	37.79N	88.50W	6.5	0.0	4.50	3.0	0.	NUT
1925	4	27	4	5	0.0	38.29N	87.59W	6.5	0.0	4.80	0.0	0.	NUT
1926	11	5	15	53	0.0	39.09N	82.09W	6.5	0.0	3.40	0.0	0.	NUT
1931	12	17	3	36	0.0	34.09N	89.80W	6.5	0.0	4.70	0.0	0.	NUT
1937	9	30	7	58	0.0	45.50N	65.80W	0.0	5.0	0.00	0.0	0.	WES
1961	7	5	22	43	0.0	50.30N	66.70W	0.0	5.0	0.00	0.0	0.	WES
1964	1	8	10	4	0.0	46.20N	77.50W	5.0	5.0	0.00	0.0	0.	WES
1964	2	13	19	46	38.8	40.00N	78.00W	0.0	5.0	0.00	0.0	0.	WES
1964	8	15	3	51	0.0	48.20N	80.00W	0.0	5.0	0.00	0.0	0.	WES
1966	1	5	0	37	17.8	39.80N	104.70W	5.0	0.0	5.00	0.0	0.	CGS
1970	6	25	16	8	54.6	39.60N	71.00W	0.0	0.0	5.00	0.0	0.	CGS
1976	3	25	0	41	20.0	35.59N	90.50W	6.0	0.0	5.00	0.0	0.	NUT
1979	8	19	22	49	31.0	47.67N	69.90W	5.0	0.0	5.00	5.0	10.	CAN
1878	11	19	5	52	0.0	36.70N	89.30W	6.0	0.0	4.90	0.0	0.	NUT
1925	7	30	12	17	0.0	35.40N	101.30W	6.0	0.0	4.90	0.0	0.	NUT
1939	11	23	15	14	53.0	38.20N	90.09W	5.0	0.0	4.90	0.0	0.	NUT
1945	10	9	13	18	0.0	48.10N	70.00W	0.0	4.9	0.00	0.0	0.	WES
1948	1	1	18	33	0.0	47.30N	70.40W	0.0	4.9	0.00	0.0	0.	WES
1950	4	14	18	20	0.0	47.80N	75.50W	0.0	4.9	0.00	0.0	0.	WES
1952	10	14	22	4	0.0	48.00N	69.80W	5.0	0.0	4.90	3.8	0.	LLL
1955	11	21	16	10	0.0	50.60N	63.50W	0.0	4.9	0.00	0.0	0.	WES
1965	2	16	22	21	43.7	39.90N	105.00W	6.0	0.0	4.90	0.0	0.	CGS
1965	10	21	2	4	38.0	37.50N	91.00W	6.0	0.0	4.90	4.1	0.	NUT
1965	12	19	0	49	0.0	51.20N	80.80W	0.0	4.9	0.00	0.0	0.	WES
1967	4	10	19	0	25.5	39.94N	104.75W	6.0	0.0	4.90	0.0	0.	CGS
1827	7	5	11	30	0.0	38.29N	85.80W	6.0	0.0	4.80	0.0	0.	NUT
1843	2	17	5	0	0.0	35.50N	90.50W	5.0	0.0	4.80	0.0	0.	NUT
1884	9	19	20	14	0.0	40.70N	84.09W	6.0	0.0	4.80	0.0	0.	NUT
1903	2	9	0	21	0.0	37.79N	89.30W	6.0	0.0	4.80	0.0	0.	NUT
1925	9	2	11	55	0.0	37.79N	87.50W	6.0	0.0	4.80	0.0	0.	NUT
1938	8	23	5	4	0.0	40.30N	74.30W	0.0	4.8	4.00	2.7	0.	LLL
1938	8	23	9	4	0.0	40.10N	74.50W	4.0	4.8	0.00	0.0	0.	WES
1938	9	18	3	34	24.0	35.50N	90.30W	4.5	0.0	4.80	0.0	0.	NUT
1939	6	24	17	20	0.0	47.80N	70.80W	0.0	4.8	0.00	0.0	0.	WES
1948	3	12	4	29	0.0	36.00N	102.50W	6.0	0.0	4.80	0.0	0.	NUT
1950	6	29	9	13	0.0	49.90N	68.10W	0.0	4.8	0.00	0.0	0.	WES
1951	6	28	1	3	0.0	50.00N	67.50W	0.0	4.8	0.00	0.0	0.	WES
1957	3	23	19	2	0.0	40.60N	74.80W	6.0	4.8	0.00	0.0	0.	WES
1957	4	26	11	40	0.0	43.60N	69.80W	6.0	4.7	4.80	3.9	0.	LLL
1957	10	16	19	13	0.0	50.50N	64.90W	0.0	4.8	0.00	0.0	0.	WES
1963	11	5	22	45	3.4	27.80N	92.40W	0.0	0.0	4.80	0.0	0.	CGS
1965	9	14	23	16	10.4	39.50N	104.90W	0.0	0.0	4.80	0.0	0.	CGS
1967	5	11	21	15	6.6	43.66N	105.90W	0.0	0.0	4.80	0.0	0.	CGS
1973	6	15	1	9	0.0	45.30N	70.90W	6.0	0.0	4.80	0.0	0.	WES
1974	8	2	8	52	9.8	33.90N	82.50W	6.0	0.0	4.80	0.0	0.	BOL
1975	7	9	14	54	15.0	45.50N	96.09W	6.0	0.0	4.80	0.0	0.	NUT
1975	8	1	7	27	57.3	31.42N	104.01W	0.0	0.0	4.80	0.0	0.	GS
1744	6	14	15	15	0.0	42.20N	71.20W	6.0	0.0	4.70	0.0	0.	LLL

Table 3.4.1 (Continued)

YEAR	MO	DY	HR	MN	SEC	LAT	LONG	INT	ML	MB	MS	FD	SOURCE
	CZ	LLNL	CAT										
1840	11	11	0	0	0.0	39.80N	75.20W	7.0	0.0	0.00	0.0	0.	WES
1855	2	8	11	30	0.0	46.00N	64.50W	7.0	0.0	0.00	0.0	0.	WES
1861	7	13	2	0	0.0	45.40N	75.40W	7.0	0.0	0.00	0.0	0.	WES
1867	4	24	20	22	0.0	39.20N	96.30W	7.0	0.0	5.10	0.0	0.	NUT
1871	10	9	14	40	0.0	39.70N	75.50W	7.0	0.0	0.00	0.0	0.	EQH
1872	1	10	0	54	0.0	47.50N	70.50W	7.0	0.0	0.00	0.0	0.	WES
1875	12	23	4	45	0.0	37.60N	78.50W	7.0	0.0	0.00	0.0	0.	EQH
1877	11	15	17	45	0.0	41.00N	97.00W	7.0	0.0	5.00	0.0	0.	NUT
1884	8	10	19	7	0.0	40.60N	74.00W	7.0	0.0	0.00	0.0	0.	WES
1886	10	22	19	45	0.0	32.90N	80.00W	7.0	0.0	0.00	0.0	0.	EQH
1891	1	8	6	0	0.0	31.70N	95.19W	7.0	0.0	3.80	0.0	0.	NUT
1893	11	27	16	50	0.0	45.50N	73.30W	7.0	0.0	0.00	0.0	0.	WES
1897	3	23	23	7	0.0	45.50N	73.60W	7.0	0.0	0.00	0.0	0.	WES
1897	3	28	3	14	0.0	45.50N	73.60W	7.0	0.0	0.00	0.0	0.	WES
1903	11	4	18	18	0.0	36.90N	89.30W	7.0	0.0	4.90	0.0	0.	NUT
1905	1	27	0	0	0.0	34.00N	86.00W	7.0	0.0	0.00	0.0	0.	BOL
1905	1	28	0	0	0.0	34.00N	86.00W	7.0	0.0	0.00	0.0	0.	BOL
1905	7	27	0	20	0.0	47.29N	88.40W	7.0	0.0	4.50	0.0	0.	NUT
1909	5	26	14	42	0.0	42.00N	89.00W	7.0	0.0	5.10	0.0	0.	NUT
1909	7	19	4	34	0.0	40.20N	90.00W	7.0	0.0	4.50	0.0	0.	NUT
1909	9	27	9	45	0.0	39.50N	87.40W	7.0	0.0	4.80	0.0	0.	NUT
1912	6	12	10	30	0.0	32.90N	80.00W	7.0	0.0	0.00	0.0	0.	EUS
1913	1	1	18	28	0.0	34.70N	81.70W	7.0	0.0	0.00	0.0	0.	EQH
1913	3	28	21	50	0.0	36.20N	83.69W	7.0	0.0	4.00	0.0	0.	NUT
1916	2	21	17	39	0.0	35.50N	82.50W	7.0	0.0	0.00	0.0	0.	BOL
1916	10	18	21	4	0.0	33.50N	86.20W	7.0	0.0	0.00	0.0	0.	EQH
1916	10	18	22	3	40.0	33.50N	86.20W	7.0	0.0	0.00	0.0	0.	EUS
1923	10	28	17	10	0.0	35.50N	90.40W	7.0	0.0	4.50	0.0	0.	NUT
1927	5	7	8	28	0.0	35.70N	90.59W	7.0	0.0	4.80	0.0	0.	NUT
1927	6	1	12	23	0.0	40.30N	74.00W	7.0	0.0	0.00	0.0	0.	WES
1930	9	30	20	40	0.0	40.29N	84.30W	7.0	0.0	4.20	0.0	0.	NUT
1931	4	20	19	54	0.0	43.40N	73.70W	7.0	0.0	4.70	0.0	0.	LLL
1931	9	20	23	4	54.0	40.40N	84.19W	7.0	0.0	4.60	3.6	0.	NUT
1935	3	1	10	59	44.0	40.29N	96.19W	7.0	0.0	4.70	3.0	0.	NUT
1937	3	2	14	47	36.0	40.40N	84.19W	7.0	0.0	4.80	0.0	0.	NUT
1952	4	9	16	29	29.0	35.40N	97.80W	7.0	0.0	5.10	5.5	0.	NUT
1954	2	21	20	0	0.0	41.20N	75.90W	7.0	0.0	0.00	0.0	0.	WES
1956	10	30	10	36	21.0	36.20N	95.90W	7.0	0.0	4.20	0.0	0.	NUT
1964	3	28	10	8	45.0	42.79N	101.69W	7.0	0.0	4.70	0.0	0.	NUT
1965	8	14	13	13	54.0	37.09N	89.19W	7.0	0.0	3.80	0.0	0.	NUT
1980	7	27	18	52	22.0	38.17N	83.91W	7.0	0.0	5.00	5.1	8.	CAN
1939	10	27	1	36	0.0	47.80N	70.00W	0.0	5.2	0.00	0.0	0.	WES
1967	11	27	5	9	22.7	40.00N	104.70W	6.0	0.0	5.20	0.0	0.	USE
1944	6	23	6	37	0.0	49.40N	67.80W	0.0	5.1	0.00	0.0	0.	WES
1944	11	5	19	7	0.0	48.70N	80.80W	0.0	5.1	0.00	0.0	0.	WES
1951	9	19	8	19	0.0	49.30N	66.30W	0.0	5.1	0.00	0.0	0.	WES
1953	9	14	22	52	0.0	49.10N	65.20W	4.0	5.1	0.00	0.0	0.	WES
1965	7	15	14	16	7.0	37.30N	74.40W	0.0	0.0	5.10	0.0	0.	CGS
1965	9	16	19	51	9.7	37.30N	74.40W	0.0	0.0	5.10	0.0	0.	CGS
1860	0	0	0	0	0.0	46.00N	94.80W	6.5	0.0	5.00	0.0	0.	NUT
1883	4	12	8	30	0.0	37.00N	89.19W	6.5	0.0	4.00	0.0	0.	NUT

Table 3.4.2
Listing of the 150 Largest Earthquakes in the EPRI
Catalog since 1700 - Only Preferred Entries Selected

YEAR	CZ MO	EPRI CAT DY	HR	MN	SEC	LAT	LONG	INT	ML	MB	MS	SOURCE
1812	2	7	9	45	.0	36.50N	89.60W	11.5	0.0	7.28	7.4	185 183
1811	12	16	8	15	.0	36.00N	90.00W	11.0	0.0	7.08	7.2	182 MAIN
1886	8	31	21	50	.0	32.90N	80.00W	10.0	0.0	7.04	6.6	766 MAIN
1886	9	1	2	51	.0	32.90N	80.00W	10.0	0.0	7.04	0.0	767 766
1812	1	23	15	0	.0	36.30N	89.60W	10.5	0.0	6.98	7.1	183 MAIN
1870	10	20	16	30	.0	47.40N	70.50W	8.5	6.5	6.15	0.0	445 MAIN
1925	3	1	2	19	14.7	47.76N	69.84W	9.0	0.0	6.48	6.6	1445 MAIN
1895	10	31	11	8	.0	37.00N	89.40W	9.0	0.0	6.08	6.2	933 MAIN
1928	11	1	4	12	49.0	27.00N	105.50W	0.0	0.0	6.18	6.3	1615 MAIN
1935	11	1	6	3	34.2	46.87N	79.05W	0.0	0.0	6.08	6.2	1879 MAIN
1791	12	6	20	0	.0	47.40N	70.50W	7.5	6.0	5.68	0.0	147 MAIN
1732	9	16	16	0	.0	45.50N	73.60W	8.0	0.0	5.98	0.0	80 MAIN
1755	11	18	9	12	.0	42.70N	70.30W	8.0	0.0	5.98	0.0	102 MAIN
1860	10	17	11	15	.0	47.50N	70.10W	8.0	0.0	5.98	0.0	413 MAIN
1897	5	31	18	58	.0	37.30N	80.70W	7.5	0.0	5.98	5.8	970 MAIN
1931	8	16	11	40	22.3	30.50N	104.57W	8.0	0.0	5.98	5.8	1758 MAIN
1939	11	19	11	54	.0	47.80N	70.00W	0.0	0.0	5.92	5.7	2071 MAIN
1843	1	5	2	45	.0	35.50N	90.50W	8.0	0.0	5.88	6.0	255 MAIN
1909	5	16	4	15	.0	50.00N	105.00W	0.0	0.0	5.86	0.0	1154 MAIN
1882	10	22	22	15	.0	33.60N	95.60W	8.0	0.0	5.46	5.5	659 MAIN
1944	9	5	4	38	45.7	44.96N	74.72W	8.0	0.0	5.68	5.8	2235 MAIN
1785	1	2	12	15	.0	40.00N	67.00W	7.0	5.7	5.39	0.0	139 MAIN
1816	9	9	0	0	.0	45.50N	73.60W	7.0	5.7	5.39	0.0	192 MAIN
1817	10	5	16	45	.0	42.50N	71.20W	5.5	5.7	4.51	4.3	197 MAIN
1831	5	0	0	0	.0	47.30N	70.50W	7.0	5.7	5.39	0.0	232 MAIN
1893	11	27	16	50	.0	45.50N	73.30W	7.0	5.7	5.39	0.0	890 MAIN
1891	9	27	4	55	.0	38.30N	88.50W	7.0	0.0	5.68	5.8	869 MAIN
1882	1	9	12	53	52.0	47.00N	66.60W	0.0	0.0	5.58	5.7	7593 MAIN
1838	6	9	14	45	.0	38.50N	89.00W	7.5	0.0	5.39	5.7	243 MAIN
1906	1	8	0	15	.0	39.20N	96.50W	7.5	0.0	4.78	4.9	1074 MAIN
1914	2	10	18	31	.0	46.00N	75.00W	7.0	5.5	5.33	0.0	1233 MAIN
1924	9	30	8	52	30.0	47.80N	69.80W	7.0	5.5	5.33	0.0	1436 MAIN
1939	10	19	11	53	54.0	48.02N	69.73W	0.0	0.0	5.48	5.6	2059 2071
1974	3	27	16	10	56.3	38.55N	90.13W	3.0	0.0	5.48	0.0	3545 MAIN
1931	1	8	0	14	36.5	47.30N	70.40W	0.0	5.4	4.80	0.0	1732 MAIN
1727	11	10	3	40	.0	42.80N	70.60W	7.0	0.0	5.39	5.0	40 MAIN
1737	12	19	4	0	.0	40.80N	74.00W	7.0	0.0	5.39	0.0	87 MAIN
1774	2	21	19	0	.0	37.20N	77.40W	7.0	0.0	5.39	0.0	125 MAIN
1840	11	11	0	0	.0	39.80N	75.20W	7.0	0.0	5.39	4.0	249 MAIN
1871	10	9	14	40	.0	39.70N	75.50W	7.0	0.0	5.39	4.0	460 MAIN
1875	12	23	4	45	.0	37.60N	78.50W	7.0	0.0	5.39	0.0	534 MAIN
1884	8	10	19	7	.0	40.60N	74.00W	7.0	0.0	5.39	0.0	704 MAIN
1886	10	22	19	45	.0	32.90N	80.00W	7.0	0.0	5.39	0.0	788 766
1897	3	28	3	14	.0	45.50N	73.60W	7.0	0.0	5.39	0.0	964 MAIN
1909	9	27	9	45	.0	39.50N	87.40W	7.0	0.0	5.39	4.8	1161 MAIN
1912	6	12	10	30	.0	32.90N	80.00W	7.0	0.0	5.39	0.0	1201 MAIN
1913	1	1	18	28	.0	34.70N	81.70W	7.0	0.0	5.39	0.0	1212 MAIN
1916	2	21	17	39	.0	35.50N	82.50W	7.0	0.0	5.39	0.0	1269 MAIN
1916	10	18	21	4	.0	33.50N	86.20W	7.0	0.0	5.39	0.0	1280 MAIN
1980	7	27	18	52	21.7	38.18N	83.94W	7.0	0.0	5.39	5.1	6642 MAIN
1940	12	20	7	27	26.2	43.87N	71.37W	7.0	0.0	5.38	5.5	2118 MAIN

Table 3.4.2 (Continued)

CZ	EPRI CAT											
YEAR	MO	DY	HR	MN	SEC	LAT	LONG	INT	ML	RMB	MB	SOURCE
1940	12	24	13	43	45.0	43.91N	71.28W	7.0	0.0	5.38	5.5	2119 2118
1968	11	9	17	1	41.0	37.91N	88.37W	7.0	0.0	5.38	0.0	3260 MAIN
1897	11	14	0	0	.0	42.90N	106.30W	6.5	5.3	5.09	0.0	978 MAIN
1962	6	27	1	28	59.3	37.90N	88.64W	0.0	0.0	5.28	0.0	2857 MAIN
1982	1	11	21	41	8.0	47.00N	66.60W	0.0	0.0	5.28	5.4	7611 7593
1857	10	8	10	0	.0	38.70N	89.20W	7.0	0.0	5.18	5.3	391 MAIN
1865	8	17	15	0	.0	36.50N	89.50W	7.0	0.0	5.18	5.3	428 MAIN
1867	4	24	20	22	.0	39.20N	96.30W	7.0	0.0	4.98	5.1	432 MAIN
1875	6	18	13	43	.0	40.20N	84.00W	7.0	0.0	4.89	5.3	523 MAIN
1877	11	15	17	45	.0	41.00N	97.00W	7.0	0.0	4.88	5.0	564 MAIN
1891	1	8	6	0	.0	31.70N	95.20W	7.0	0.0	3.68	3.8	864 MAIN
1903	11	4	18	18	.0	36.90N	89.30W	7.0	0.0	1.78	4.9	1046 MAIN
1905	7	27	0	20	.0	47.30N	88.40W	7.0	0.0	4.38	4.5	1067 MAIN
1905	8	22	5	8	.0	36.79N	89.59W	7.0	0.0	4.68	4.8	1068 MAIN
1909	5	26	14	42	.0	42.00N	89.00W	7.0	0.0	4.98	5.1	1155 MAIN
1909	7	19	4	34	.0	40.20N	90.00W	7.0	0.0	4.89	4.5	1157 MAIN
1913	3	28	21	50	.0	36.20N	83.70W	7.0	0.0	3.88	4.0	1214 MAIN
1923	10	28	17	10	.0	35.50N	90.40W	7.0	0.0	4.38	4.5	1417 MAIN
1927	5	7	8	28	.0	35.70N	90.60W	7.0	0.0	4.68	4.8	1568 MAIN
1930	9	30	20	40	.0	40.30N	84.30W	7.0	0.0	4.08	4.2	1711 MAIN
1952	4	9	16	29	28.4	35.40N	97.85W	7.0	0.0	4.98	5.1	2459 MAIN
1964	3	28	4	8	45.0	42.80N	101.70W	7.0	0.0	4.58	4.7	2944 MAIN
1944	6	23	6	37	53.0	49.42N	67.75W	0.0	5.1	4.80	0.0	2233 MAIN
1944	11	5	19	7	.0	48.70N	80.80W	0.0	5.1	4.80	0.0	2252 MAIN
1791	5	16	13	0	.0	41.50N	72.40W	6.5	0.0	5.09	0.0	144 145
1860	0	0	0	0	.0	46.00N	94.80W	6.5	0.0	5.09	4.6	407 MAIN
1926	11	5	15	53	.0	39.10N	82.10W	6.5	0.0	5.09	0.0	1538 MAIN
1927	6	1	12	23	.0	40.30N	74.00W	6.5	0.0	5.09	3.8	1570 MAIN
1929	8	12	11	24	48.7	42.91N	78.40W	0.0	0.0	5.08	5.2	1649 MAIN
1983	10	7	10	18	47.0	44.03N	74.31W	0.0	0.0	5.08	5.2	8897 MAIN
1761	3	12	7	15	.0	42.50N	71.00W	5.0	5.0	4.21	0.0	113 MAIN
1783	11	29	0	0	.0	41.00N	74.50W	6.0	5.0	4.80	0.0	133 MAIN
1816	9	16	0	0	.0	45.50N	73.60W	6.0	5.0	4.80	0.0	193 192
1831	7	14	0	0	.0	47.60N	70.10W	6.0	5.0	4.80	0.0	233 MAIN
1842	11	9	0	0	.0	46.00N	73.20W	6.0	5.0	4.80	0.0	254 MAIN
1861	7	12	0	0	.0	45.40N	75.40W	6.0	5.0	4.80	0.0	416 MAIN
1864	4	20	18	15	.0	46.90N	71.20W	6.0	5.0	4.80	0.0	425 MAIN
1867	12	18	3	0	.0	44.65N	75.15W	6.0	5.0	4.80	0.0	434 MAIN
1869	10	22	11	0	.0	45.00N	66.20W	6.0	5.0	4.80	0.0	440 MAIN
1872	1	9	0	0	.0	47.50N	70.50W	6.0	5.0	4.80	0.0	461 445
1877	11	4	0	0	.0	45.20N	73.90W	6.0	5.0	4.80	0.0	562 MAIN
1883	4	12	8	30	.0	37.00N	89.20W	6.5	0.0	3.88	4.0	683 649
1897	3	23	0	0	.0	45.50N	73.60W	6.0	5.0	4.80	0.0	962 964
1899	4	30	2	5	.0	38.50N	87.00W	6.5	0.0	4.48	4.6	1000 MAIN
1904	3	21	6	4	.0	45.00N	67.20W	6.0	5.0	4.80	0.0	1056 MAIN
1910	2	0	0	0	.0	48.00N	70.00W	6.0	5.0	4.80	0.0	1172 MAIN
1917	9	3	21	30	.0	46.30N	94.80W	6.5	0.0	4.18	4.8	1316 MAIN
1922	11	27	3	31	.0	37.80N	88.50W	6.5	0.0	4.38	4.5	1407 MAIN
1925	3	1	4	30	42.0	47.80N	69.80W	6.0	5.0	4.80	0.0	1446 1445
1925	3	21	15	22	4.0	47.80N	69.80W	6.0	5.0	4.80	0.0	1456 1445
1925	4	27	4	5	.0	38.30N	87.60W	6.5	0.0	4.68	4.8	1465 MAIN

Table 3.4.2 (Continued)

CZ EPRI CAT

YEAR	MO	DY	HR	MN	SEC	LAT	LONG	INT	ML	RMB	MS	SOURCE
1928	12	1	0	0	.0	50.00N	81.50W	6.0	5.0	4.80	0.0	1624 MAIN
1931	12	17	3	36	.0	34.10N	89.80W	6.5	0.0	4.58	4.7	1772 MAIN
1943	1	14	21	32	38.0	45.30N	69.60W	5.0	5.0	4.18	4.3	2192 MAIN
1943	6	25	4	25	24.0	48.50N	105.00W	0.0	5.0	4.73	0.0	2209 MAIN
1958	5	14	17	41	16.7	47.09N	76.82W	0.0	5.0	4.88	0.0	2732 MAIN
1963	10	30	17	37	.0	42.70N	70.80W	0.0	5.0	4.73	0.0	2922 MAIN
1966	6	26	6	0	.0	44.30N	103.40W	0.0	5.0	4.73	0.0	3101 MAIN
1982	1	9	16	36	45.0	47.00N	66.60W	0.0	0.0	4.98	5.1	7602 7593
1950	4	14	18	20	48.5	47.83N	75.50W	0.0	4.9	4.66	0.0	2402 MAIN
1965	12	19	0	49	.0	51.20N	80.80W	0.0	4.9	4.66	0.0	3077 MAIN
1917	4	9	20	52	.0	38.10N	90.20W	6.0	0.0	4.88	5.0	1305 MAIN
1945	6	18	15	20	4.7	47.34N	71.09W	0.0	4.7	4.88	0.0	2269 MAIN
1976	3	25	0	41	20.8	35.58N	90.48W	6.0	0.0	4.88	5.0	4101 MAIN
1979	8	19	22	49	.0	47.67N	69.90W	5.0	0.0	4.88	5.0	6132 6132
1979	8	19	22	49	30.4	47.67N	69.90W	0.0	0.0	4.88	0.0	6132 6132
1982	3	31	21	2	20.0	47.00N	66.60W	0.0	0.0	4.88	5.0	7820 7593
1982	1	19	0	14	42.7	43.51N	71.62W	0.0	0.0	4.86	0.0	7652 MAIN
1744	6	14	15	15	.0	42.50N	70.90W	6.0	0.0	4.80	0.0	93 MAIN
1776	0	0	0	0	.0	39.90N	82.00W	6.0	0.0	4.80	0.0	128 MAIN
1780	2	6	0	0	.0	30.40N	87.20W	6.0	0.0	4.80	0.0	130 MAIN
1783	11	30	3	50	.0	41.00N	74.50W	6.0	0.0	4.80	0.0	135 133
1796	12	26	11	0	.0	42.90N	79.00W	6.0	0.0	4.80	0.0	157 MAIN
1827	8	7	4	30	.0	38.30N	85.80W	6.0	0.0	4.80	4.7	221 220
1827	8	7	7	0	.0	38.30N	85.80W	6.0	0.0	4.80	4.7	222 220
1833	8	27	11	0	.0	37.70N	78.00W	6.0	0.0	4.80	5.0	238 MAIN
1840	1	16	20	0	.0	43.00N	75.00W	6.0	0.0	4.80	0.0	245 MAIN
1848	9	9	0	0	.0	40.00N	73.70W	6.0	0.0	4.80	0.0	299 MAIN
1852	4	29	6	0	.0	36.80N	82.50W	6.0	0.0	4.80	0.0	319 MAIN
1852	4	29	13	0	.0	36.60N	81.60W	6.0	0.0	4.80	4.9	320 MAIN
1852	11	2	23	35	.0	37.60N	78.60W	6.0	0.0	4.80	4.3	326 MAIN
1853	3	12	7	3	.0	43.70N	75.50W	6.0	0.0	4.80	0.0	330 MAIN
1853	5	20	0	0	.0	34.00N	81.20W	6.0	0.0	4.80	0.0	333 MAIN
1857	10	23	20	15	.0	43.20N	78.60W	6.0	0.0	4.80	0.0	392 MAIN
1857	12	23	18	30	.0	44.10N	70.20W	6.0	0.0	4.80	3.8	395 MAIN
1861	8	31	10	22	.0	36.10N	81.10W	6.0	0.0	4.80	5.1	418 MAIN
1874	2	10	0	0	.0	35.70N	82.10W	6.0	0.0	4.80	0.0	502 MAIN
1875	11	2	2	55	.0	33.80N	82.50W	6.0	0.0	4.80	0.0	529 MAIN
1879	1	13	4	45	.0	29.50N	82.00W	6.0	0.0	4.80	0.0	579 MAIN
1885	10	10	4	35	.0	37.70N	78.80W	5.0	0.0	4.80	4.2	744 MAIN
1886	8	28	8	45	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	763 766
1886	9	1	6	5	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	768 766
1886	9	4	4	1	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	772 766
1886	9	6	4	6	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	776 766
1886	9	17	6	29	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	780 766
1886	9	21	10	15	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	781 766
1886	9	27	19	2	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	783 766
1886	10	9	6	48	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	785 766
1886	10	22	10	20	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	787 766
1886	11	5	17	20	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	791 766
1887	1	4	11	44	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	793 766
1888	1	12	15	54	.0	32.90N	80.00W	6.0	0.0	4.80	0.0	827 766

APPENDIX G

PETROGRAPHY OF TWENTY-FIVE THIN SECTIONS FROM DIAMOND DRILL CORE FROM THE GOSHEN GNEISS DOME WESTERN MASSACHUSETTS

Petrography of Twenty-Five Thin Sections from Diamond Drill Core from the Goshen Gneiss Dome, Western Massachusetts

by
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with
Editorial Assistance and Genetic Interpretations

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Introduction

The Goshen dome is one of several gneiss domes which crop out west of the Connecticut Valley Mesozoic basin, west-central New England, and expose pre-Silurian rocks that lie beneath the Silurian-Devonian Goshen, Waits River and Gile Mountain Formations. The rocks in the core of this dome are associated with the tectonically-thinned western edge of the Bronson Hill volcanic arc complex (Stanley & Ratcliffe, 1985). This volcanic arc complex is supposed to have collided with the North American continent during the Middle Ordovician Taconian orogeny. The arc-complex gneisses are thought to have been tectonically thrust over the stratigraphically-younger forearc sequence along the Bristol thrust (Stanley & Ratcliffe, 1985).

The pre-Silurian rocks exposed in the Goshen dome are within the stratigraphically lower Collinsville Formation and the overlying Cobble Mountain Formation (Zen et al., 1983). The westward-thinning Bristol Member of the Collinsville Formation is made up of gneiss and amphibolite (Stanley & Ratcliffe, 1985). This unit closely resembles plagioclase gneisses and amphibolites abundantly exposed in the gneiss domes of the Bronson Hill anticlinorium to the east, that are considered to be of mixed volcanic and plutonic origin (Robinson & Hall, 1980). In the Pelham dome of the Bronson Hill anticlinorium, the plagioclase gneisses

and amphibolites overlie gneisses and metamorphosed sedimentary rocks of Proterozoic age (Hall & Robinson, 1982). The lower members of the Cobble Mountain Formation contain interbedded granular rocks and pelites. The abundance of feldspar and mafic and felsic volcanic rocks indicate a source to the east in the Bronson Hill arc complex (Stanley and Ratcliffe, 1985). The upper feldspathic schist member contains kyanite-sillimanite schists or schistose amphibolites and ultramafic rocks (Zen et. al., 1983; Stanley and Ratcliffe, 1985).

The location of the drill hole is on the east side of the gneiss dome where the dominant foliation is dipping east at 35 to 45 degrees (Hatch and Warren, 1981).

Sampling and Laboratory Techniques

Twenty-five samples from the 1000-foot Goshen dome diamond drill core have been selected for petrographic study. The samples were selected by the writer in consultation with Peter Robinson such that several representative as well as peculiar rock types throughout the core are included. Samples are numbered by drilling depth, such that sample #73 is the physically highest sample and sample #998 is the lowest sample. Depth measurements have been rounded to whole numbers for the purpose of discussion.

Thin sections were prepared at the University of Massachusetts by Page Fallon. Detailed study of the thin sections was carried out by the writer at the University of

Massachusetts using standard petrographic microscopic techniques. Modal abundances of minerals in thin section have been visually estimated by the writer.

Description of Rock Types

For descriptive purposes the thin section samples obtained from the diamond drill core have been grouped into two major and four minor rock types. This has been done on an objective basis without regard to prior location of the contact between the Collinsville and Cobble Mountain Formations. In a later section it is shown that the results of this petrographic study required a revision of the position of this contact within the diamond drill hole.

Plagioclase Gneisses. Eleven samples are from gray to dark-gray biotite-garnet-opaque plagioclase gneisses. These gneisses all contain quartz, plagioclase, and biotite, and may also contain hornblende, cummingtonite, hastingsite, epidote, muscovite, or chlorite (Table 1). The accessory minerals apatite, zircon, sphene, calcite, ilmenite, magnetite, or sulfide may be present. Plagioclase composition ranges from An 5 to An 12. Potassic feldspar has not been observed in thin section.

There is a wide range in biotite and amphibole color in plane light within these plagioclase gneisses. Biotites in equilibrium with hornblende and cummingtonite are

Table 1. Estimated Modes of Plagioclase Gneisses

Section #	73	153	385	635	686	718	800	824	850	888	972	998
Quartz	65	5	25	48	45	42	45	30	41	40	40	50
Plag (%An)	20 (10)	65 (8)	39	41 15	39 (8)	34	40 (9)	38	30 (cr12) (rm 5)	39	50	33
Biotite	11	2	8	4	4	10	8	10	15	tr	10	7
Hornbld		5	15	tr				12		11		
Hastgs				5	5	12			12			
Cumm		15	4					3				
Epidote				1	3	1	4		tr	1	tr	
Garnet	1	5	3		1	tr	1	3	tr	3	tr	1
Chlorite	2	tr	4		2	tr	tr	3	tr	4	tr	8
Muscovite							1					1
Opaque (magn)	1 x	3 x	2 x	tr x	1 x	1	1	1	2	2 x	tr x	tr x
Apatite	tr		tr		tr	tr		tr	tr	tr	tr	
Zircon	tr		tr		tr	tr		tr	tr	tr	tr	tr
Sphene							tr				tr	tr
Calcite			tr									

Table 1(cont.)
Plagioclase Gneiss

73. Strongly magnetic, laminated, garnet-chlorite-biotite-magnetite gneiss; laminae of biotite-rich and biotite-poor layers on scale of 1-3 cm; grainsize less than 4mm.

153. Strongly magnetic, weakly foliated, gray, garnet-magnetite-amphibole gneiss; garnet porphyroblasts less than 7 mm diameter.

385. Coarse, hornblende-cummingtonite-*chlorite-*biotite gneiss with minor garnet and magnetite; layers of quartz-rich and mica-rich composition; oblong pods of polycrystalline quartz 2 cm in length common. Slightly magnetic.

635. Gray, slightly magnetic, biotite-hastingsite gneiss within non-magnetic, laminated to massive, dark-green, sulfide-bearing, hornblende-biotite amphibolite (Table 2).

686. Coarse, weakly magnetic, strongly foliated, gray, hastingsite-biotite plagioclase gneiss with darker gray inclusions.

718. Layered gray to dark-gray, biotite-hastingsite gneiss with moderately to well developed foliation. Not magnetic.

800. Slightly magnetic, foliated, light-gray, coarse homogeneous biotite-magnetite plagioclase gneiss.

824. Garnet- and chlorite-bearing, slightly magnetic, biotite-amphibole gneiss; garnet porphyroblasts less than 3 mm diameter.

850. Homogeneous, intermediate- to dark-gray, biotite-amphibole gneiss; moderately-well foliated. Not magnetic.

888. Homogeneous, magnetic, dark-gray, amphibolite gneiss with garnet and abundant magnetite.

972. Homogeneous, slightly magnetic, gray, biotite gneiss with pinhead garnets.

998. Homogeneous, slightly magnetic, light-gray to green, chlorite and/or biotite gneiss with local magnetite.

commonly olive-green to green-brown in the Z=Y direction and tan to colorless in the X direction. Biotites in equilibrium with hastingsite or epidote are commonly brown to opaque-brown in the Z=Y direction and tan to colorless in the X direction. Cummingtonite is colorless in plane light, hornblende is pleochroic green or blue-green to tan, and hastingsite is pleochroic dark blue-green to green or tan.

In this report the distinction between normal hornblende and hastingsite, a variety of hornblende abnormally rich in Fe+2 and Fe+3, is based on the abnormally small 2V of 20-30 degrees (versus 50-60 degrees for normal hornblende) and the unusually strong blue-green color. Such properties were also observed by Hodgkins (1985) in analyzed hastingsites from the microcline gneisses of the Dry Hill Gneiss of the Pelham dome (see also Ashenden, 1973).

The plagioclase gneisses are weakly- to strongly-foliated. Foliation is defined by mica or amphibole orientation, by segregated layering, or both. The rocks may also contain compositional laminae ranging from a few millimeters to a few centimeters in thickness. This lamination may represent original volcanic layering in some samples. Grain size is less than 4 mm except for garnet porphyroblasts in sample #153 which are less than 7 mm in diameter.

Sample #635 is an amphibolite with interbedded gneiss. A mode of the gneissic layer in thin section is

listed with plagioclase gneisses (Table 1) for comparison. An amphibolite mode for this sample is given in Table 2. Since there appears to be no modal potassic feldspar in these gneisses, the protoliths must have been potassium deficient. Low potassium andesites to rhyolites or their intrusive equivalents could produce such plagioclase gneisses. Rocks containing cummingtonite are low in calcium, relative to aluminum, while rocks containing hastingsite are probably rich in iron. The chemical trends suggested by the presence of each of these minerals may relate to the tectonic setting and chemical conditions within the magmatic source regions.

Amphibolite. Eight samples are dominated by dark-green to dark-gray hornblende or hornblende-biotite amphibolite. These all contain quartz plagioclase, and hornblende, and may contain biotite, actinolite, cummingtonite, epidote, garnet, sphene, chlorite, magnetite, or ilmenite (Table 2). Accessory minerals include zircon, apatite, sulfide, or calcite. Modal quartz ranges from 10-15%. Plagioclase may or may not show albite twinning and is commonly strongly zoned. Plagioclase composition ranges from An 5 to An 16.

Biotite color is commonly medium brown in the Z=Y direction and tan in the X direction. Biotite in the two sphene-bearing amphibolites is orange-brown in the Z=Y

Table 2. Estimated Modes of amphibolites and interbedded epidote-augite-hornblende gneisses (Gns).

Section #	127	Gns 320	339	Gns 339	463	537	573	635	666	957
Quartz	10	10	10	3	15	10	10	15	15	15
Plagioclase	30	40	30	23	40	40	19	25	24	35
(An% core)	(12)					(16)	(12)	(15)	(9)	
(rim)	(5)									
Biotite	20	tr			5	2	1	20	8	tr
Hornblende	35	18	40	2	37	46	65	40	50	47
Actinolite		tr	5	5						
Cumm							1			
Hastg				tr						
Augite		10		27						
Epid	3	22	15	40						
Garnet							2			
Sphene		tr							3	3
Chlorite						tr	1			
Opaque	2	tr			3	2	1		tr	tr
(mag)					x	x	x			
(ilm)	x	x			x				x?	x?
Zircon					tr		tr		tr	
Apatite						tr			tr	
Sulfide					tr	tr	tr	tr	tr	
Calcite	tr						tr			
Prehnite									tr	

Table 2 (cont.)
Amphibolite

127. Coarse, well foliated, dark-green, hornblende-biotite amphibolite; grainsize less than 1 cm; homogeneous appearance. Not magnetic.

320(Gns). Well foliated, laminated, gray to brown, epidote-hornblende gneiss and hornblende gneiss; laminae on scale of 1-3 mm; hornblende lineation; minor interlayers of biotite gneiss. Not magnetic.

339. Interlayered, dark-gray, hornblende-epidote amphibolite with green, epidote-augite-hornblende gneiss (not magnetic) containing strongly-magnetic, blue, magnetite-garnet bed (Table 3); hornblende lineation.

339(Gns). Green epidote-augite-hornblende gneiss (not magnetic) within interlayered, dark-gray, hornblende-epidote amphibolite (above, this table) containing strongly magnetic, blue, magnetite-garnet bed (Table 3).

463. Well foliated, weakly magnetic, sulfide-bearing, dark-gray, hornblende-biotite amphibolite and gneiss; banded on scale of 1-2 cm.

537. Well foliated, weakly magnetic, sulfide-bearing, dark-gray, hornblende amphibolite with minor biotite and garnet; relict porphyroblasts less than 1 cm.

573. Well foliated, slightly magnetic, sulfide-bearing, dark-green, garnet-hornblende amphibolite; garnet porphyroblasts 1-2 cm diameter; sulfide and quartz concentrations associated with garnet porphyroblasts.

635. Laminated to massive, sulfide-bearing, dark-green, hornblende-biotite amphibolite (not magnetic) with minor gray, slightly magnetic, biotite-hastingsite gneiss (Table 1).

666. Well layered to massive, sulfide-bearing, dark-green, biotite-hornblende-sphene amphibolite. Not magnetic.

957. Homogeneous, strongly foliated, dark-green, hornblende-sphene amphibolite sill. Not magnetic.

direction and tan to colorless in the X direction. Hornblende is pleochroic green or blue-green to tan in plane light.

The amphibolites are commonly well foliated and may contain compositional laminae on the scale of a few centimeters. Grain size is generally less than 4 mm in length, however one sample (#573) contains garnet porphyroblasts 1-2 cm diameter.

The protoliths for the amphibolites may have been mafic volcanic rock, such as basalt, basaltic andesite or andesite, or intrusive equivalents. All of the amphibolites studied have some modal quartz suggesting a relatively silicic source rock.

Epidote-Augite-Hornblende Gneiss within Amphibolite. Two samples are epidote-augite-hornblende gneiss which are interlayered with amphibolite. Epidote and augite are closely associated with one another in greenish laminae which may be up to a few centimeters thick. These gneisses contain quartz, plagioclase, hornblende, and actinolite, and may contain epidote, augite, biotite, sphene, opaque, or hastingsite (Table 2). Hornblende is pleochroic green or bluish-green to tan. Epidote is yellow-green in hand sample and gives the rock a greenish appearance.

The rock exhibits a weakly to well developed hornblende foliation, depending upon modal abundance of

hornblende. Irregular laminae of epidote-augite-rich and hornblende-rich layers are common. Average grain size is less than 3 mm.

Sample #339 contains a bluish magnetite-garnet bed (Mode given in Table 3). The contact of the epidote-augite-hornblende gneiss with this magnetite-garnet bed contains hastingsite, actinolite, and augite (Table 2).

Muscovite-Biotite-Garnet Gneiss. Three of the samples are muscovite-biotite-garnet gneisses. These gneisses contain quartz, plagioclase, muscovite, biotite, garnet, and magnetite (opaque identification based largely on strong magnetic character of this rock) and may contain chlorite, zircon, or apatite in trace amounts (Table 3). Each of these contain abundant tiny garnets with diameters less than 0.5 mm, characteristic of coticule rocks, giving the rock a pinkish appearance in hand sample. It is probable that these garnets are rich in manganese.

Plagioclase grains commonly include biotite, magnetite, muscovite, or quartz. The larger grains may be recrystallized volcanic phenocrysts. The opaques are probably largely magnetite though some ilmenite may also be present. Biotite color is olive-green to green in the Z=Y direction and tan to colorless in the X direction.

Each of these gneisses exhibits well developed mica foliation. One sample (#180) contains a weak secondary

Table 3. Estimated Modes of Muscovite Gneiss, Ultramafic Rock, and Kyanite Schist, and Magnetite-Garnet Quartzite.

	Musc-Bio-Gar Gneiss			Ultra-mafic	Kyanite Schist	Mag-Gar Quartzite
Section #	180	248	253	198	370	339
Quartz	20	25	30	5	40	87
Plag (An%)	54	20	20	10 (17)	20	
Biotite	10	8	5	tr	8	
Musc	10	30	40		25	
Hnbl				35		
Garnet	3	12	3			5
Chlorite			tr	40		
Opaque	3	5	2		2	8
(mag)	x	x	x			x
(ilm)		x	x		x	
Rutile				tr		
Zircon	tr		tr			
Apatite	tr					
Talc				10		
Kyanite					5	

Table 3 (cont.)

Muscovite-Biotite-Garnet Gneiss

180. Strongly magnetic, well foliated, bluish-gray, garnet-magnetite-biotite-muscovite gneiss; with pink, garnet-rich layers approximately 1 cm thick; weak crenulation in dominant mica foliation.

248. Strongly magnetic, well foliated, pink to gray, muscovite-garnet-magnetite gneiss; magnetite grains up to 3 mm diameter; irregular laminae of quartz-rich layers and 1 cm thick pink coticule-like layers.

253. Weakly magnetic, well foliated, muscovite-biotite-garnet gneiss with local magnetite grains less than 2 mm diameter; compositional layering on scale of 1-2 mm; friable.

Ultramafic Rock

198. Well foliated, fine-grained, dark-green, hornblende-chlorite-talc ultramafic rock; homogeneous appearance. Not magnetic.

Kyanite Schist

370. Very coarse, muscovite-kyanite-ilmenite schist; mica foliation exhibits small crenulation folding; books of mica up to 1-2 cm thick; kyanite less than 5 mm in length; friable. Not magnetic.

Magnetite-Garnet Quartzite

339. Strongly magnetic, blue, magnetite-garnet layer within non-magnetic, interlayered, dark gray, hornblende-epidote amphibolite with green epidote-augite-hornblende gneiss (Table 2).

biotite foliation, suggesting a later metamorphic event has taken place. Grain size is less than 4 mm in length. Large grains of magnetite may achieve 4 mm in length.

The abundance of muscovite in these samples suggests that the protolith may have been an aluminous sediment. The absence of K-feldspar suggests either a high-aluminum bulk composition or a low-potassium source. This rock may represent an altered volcanic sediment or a weathering product of nearby volcanics. The abundance of fine-grained presumably Mn-rich garnet suggests a contribution of chemical sediment from exhalations of nearby volcanics.

Ultramafic Rock. Sample #198 is a dark-green, hornblende-chlorite ultramafic rock which also contains quartz, plagioclase, talc, and a trace of biotite and rutile (Table 3). The small amount of talc gives the rock a soapy feel in hand sample. The hornblende is pleochroic light-green or blue-green to tan in thin section and may easily be mistaken for light green chlorite. Plagioclase composition is approximately An 10.

The rock contains a strong foliation defined by co-planar chlorite and hornblende. Grain size is less than 4 mm.

Kyanite Schist. Sample #370 is a light-gray quartz-rich muscovite-biotite-kyanite-ilmenite schist (Table 3) which also contains plagioclase. Kyanite is light blue in hand

sample and may achieve 4 mm in length.

Muscovite and biotite are commonly intergrown in thick books in the mica-rich laminae. Biotite is very light tan in color in plane light and is probably very Mg-rich in composition. Based on platey habit and slight magnetism, the opaque is probably ilmenite.

The rock contains quartz-rich and mica-rich laminae, approximately 1-3 mm thick. Subparallel mica grains define the well developed mica foliation which may be gently crenulated in hand sample.

This rock presents a mineralogical and petrological problem worthy of further investigation. The color of the biotite is so exceedingly pale that it is easily mistaken for the muscovite in the same rock. Such pale biotites are usually associated with extremely Mg-rich rocks in which the Ti mineral is usually rutile rather than the ilmenite that appears to be present here. If the platey mineral were hematite, one might expect a greenish tint to the biotite, indicative of the presence of Fe+3. An alternative possibility is that the ilmenite is extremely rich in the $MnTiO_3$ component. If this is true, the absence of garnet in this Al-rich bulk composition is hard to explain.

Contact between Collinsville and Cobble Mountain Formations

The contact between the Collinsville and Cobble Mountain Formations was originally judged from hand specimen

review of the drill core on February 3-7, 1986 by Professor Peter Robinson in consultation with Thomas Spinek (Ph.D. student, University of Massachusetts). The contact was placed at 674 feet at the base of a section dominated by amphibolites and above a section dominated by plagioclase gneisses with an intrusive igneous aspect. At the time, Spinek pointed out that there are some thin, fine-grained layers within the amphibolite that bear some resemblance to the more continuous plagioclase gneisses below. This placement of the contact left all muscovite- and chlorite-rich rocks in the Cobble Mountain Formation and all but one coarse-garnet-bearing layer at 824 feet also in the Cobble Mountain.

The present petrographic study has shown that many of the plagioclase gneisses below the original contact contain the unusual iron-rich amphibole, hastingsite. This mineral also occurs in a thin layer of similar gray gneiss within amphibolite in the specimen collected at 635 feet (1). This finding led to a re-examination of the core and re-location of the base of the Cobble Mountain Formation at 575 feet, based on the distribution of similar-looking gray gneiss layers in amphibolite below this level. This new interpretation is supported by the petrographic similarity (though not identity) of the sphene-bearing amphibolites at 666 feet and 957 feet. Possibly this amphibolite-rich zone at the top of the Collinsville is similar to one mapped by

Leo Hall (Pers. comm., 1980) in the Shelburne Falls dome.

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(1) The occurrence of a trace of hastingsite in the epidote-augite gneiss adjacent to a magnetite-garnet quartzite layer in amphibolite in sample #339 is considered to be irrelevant to the present context.

In the new interpretation, the contact is also much closer to the position where it was mapped on the Goshen Quadrangle Map (Hatch and Warren, 1982)(2). This placement of the contact also places all muscovite- and chlorite-rich rocks in the Cobble Mountain Formation, as well as all coarse garnet and cummingtonite-bearing rocks except the sample from 824 feet. Further petrographic research on samples in the vicinity of the revised unit boundary could produce further refinements.

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(2) The base of the Cobble Mountain Formation is placed about 600 feet west of the junction of Bissell Road on Chesterfield Road on the geologic quadrangle map. Using a mean apparent dip angle of 43 degrees, the previously located contact in the borehole would project to a position at 823 feet west of the junction, whereas the newly located contact projects to a position of 717 feet west of the junction.

Summary and Conclusions

The twenty-five rock samples studied have been divided into several rock types including plagioclase gneiss, amphibolite, epidote-augite-hornblende gneiss, muscovite-biotite-garnet gneiss, ultramafic rock, and kyanite schist. These are commonly medium- to coarse-

grained rocks exhibiting well developed foliation. Several samples contain compositional laminae ranging in thickness from a few millimeters to a few centimeters. The rocks have been metamorphosed to amphibolite grade.

Interpretation of the protoliths of these rocks is based largely on modal abundance of mafic and felsic mineral phases as well as approximate mineral compositions such as amphiboles and biotites. The presence of hastingsite indicates an iron-enrichment and the presence of cummingtonite and epidote-augite indicate calcium-depletion and calcium-enrichment, respectively. These rocks range from felsic to intermediate to mafic in bulk composition. Potassic feldspar has not been observed in any rock type in thin section.

The discovery that much of the "hornblende" in the plagioclase gneisses in the lower part of the section has the optical properties of hastingsite and that hastingsite occurs in gray gneiss interbedded with amphibolite at 635 feet led to re-examination of the core and re-placement of the base of the Cobble Mountain Formation at 575 feet. Each of the tables of modes has been divided into two parts on this basis and the characteristics of the Cobble Mountain Formation and the Collinsville Formation in the diamond drill core are summarized as follows:

The Cobble Mountain Formation is a variegated sequence of metamorphosed mafic, intermediate, and felsic

volcanic rocks and volcanogenic sediments, for the most part well layered and locally with relict primary features suggesting volcanic agglomerates. The amphibolites (Table 2, samples 127, 339, 463, 537, 573) represent mafic to intermediate lavas and tuffs locally with thin interbeds of Ca-Mn-rich sediments (Table 2, samples 320 and 339). The plagioclase gneisses with variable amounts of biotite, hornblende, cummingtonite, garnet, and chlorite (Table 1, samples 73, 153, 385) represent intermediate to felsic volcanic compositions or altered volcanic compositions. The muscovite-rich gneisses and schist (Table 3, samples 180, 248, 253, 370) bear only superficial resemblance to metamorphosed normal shales. Their volcanic heritage is suggested by the abundance of plagioclase, of magnetite, and of fine-grained, presumably Mn-rich garnet derived from a chemical sedimentary component related to volcanic hydrothermal activity. The hornblende-chlorite-talc ultramafic rock probably does not have a typical mantle ultramafic composition but appears similar to hornblende-chlorite-orthopyroxene rocks described by Tracy and others (1984) that they interpret as possible metamorphosed picritic or komatiitic lava flows.

The Collinsville Formation is dominated by plagioclase-quartz-biotite gneisses (Table 1, samples 635, 686, 718, 800, 824, 850, 888, 972, 998) that in hand specimen commonly look like metamorphosed intrusive igneous

rocks and that locally contain hastingsite or less commonly hornblende or cummingtonite. The upper part of the formation contains these rock types but is dominated by weakly layered to massive hornblende amphibolites with or without biotite and sphene (Table 2, samples 635, 666) that may represent metamorphosed volcanics or shallow intrusive rocks. A mineralogically similar amphibolite (Table 2, sample 957) occurs in a homogeneous layer that appears to be a sill with chilled margins against the enclosing plagioclase gneisses. Similar "intrusive" amphibolites have been identified within plagioclase gneisses of the Bronson Hill anticlinorium in central Massachusetts.

In the regional setting of western New England, the Collinsville Formation is recognized as part of the so-called "eastern basement" of Ordovician or older age that lay east of the Taconian subduction zone, and the Cobble Mountain Formation is considered part of the Middle Ordovician volcanic-sedimentary cover of that "basement". As usual the identification of the supposed basement-cover contact is fraught with ambiguity. The diamond drill core from the Goshen dome represents one of the most complete exposures of this difficult zone and therefore is worthy of more extended petrographic and geochemical study in future years.

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Key to Detailed Petrographic Reports

The following section contains detailed petrographic reports for each thin section sample. Reports are arranged in numerical order. An explanation of various information and abbreviations used in the reports are given here for clarity.

Mod. %. Modal percentage of each mineral listed. tr=trace amounts.

Size. Maximum size of individual mineral grains.

Shape. Shape and/or habit of typical grain or range in variety of shapes.

Color. Mineral color in plane light.

Index. Refractive index of mineral relative to quartz or mounting medium: low, moderate, or high.

Optic prop.. Lists observed optical properties of mineral. U=uniaxial; B=biaxial; 2V=n refers to estimate of 2V angle from interference figure, given in degrees.

Extinct., cleavage. Lists extinction angle of mineral relative to cleavage or twin plane. For biotite or amphibole this refers to the maximum extinction angle relative to mineral cleavage. For plagioclase, this refers to maximum extinction angle of albite twins using the Michel-Levy method for determining plagioclase composition. Measurements from core and rim of feldspar given if measured. Normally ten grains are measured. (n) Refers to number of grains measured if less than ten. Number and

angles of cleavage given if observed (cl.=cleavage). Basal cleavage in micas refers to perfect (001) cleavage.

Other. Describes other properties of interest observed in thin section. Biref.=maximum birefringence observed under crossed-polars; 1st=first order colors; 2nd=second order colors; 3rd=third order colors. Also includes information concerning optical zoning, mineral twinning, amphibole or feldspar exsolution, mineral inclusions, dispersion observed in interference figure, and sign of elongation.

Exact identity of opaque minerals was not determined in this study. Polished thin sections are necessary for accurate identification of various oxides and sulfides. However, grain shape, color in hand sample, and tests with a hand magnet make reasonable inferences possible in many cases, these are given in parentheses.

Sketches of thin-section textures were made by tracing individual grains from projected thin sections. Patterns were added to distinguish minerals. All sketches are 24x actual size with diameter of sketch equal to three millimeters.

Rock name generally lists most abundant mineral first followed by other major minerals in order of decreasing modal abundance.

PETROGRAPHIC REPORT

Sample Number Goshen--73' July, 1986

Hand Specimen Description Laminated garnet-chlorite-biotite-magnetite gneiss; laminae of biotite-rich and biotite-poor layers on scale of 1-3 cm.; grainsize less than 4 mm. Strongly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	65	2mm	equant	colorless	low	U+	undulatory	
2. Plagioclase (An_{10})	20	2mm	subhedral equant to tabular	colorless	low	B+ 2V=85°	max.=12°, slightly zoned	albite twinning
3. Biotite	11	4mm	subhedral	olive gr. tan to colorless	mod	B- 2V=2°	ext. 2-3°, basal cleav.	birefringence= 3rd order green
4. Mg Chlorite	2	1mm	subhedral	green to colorless	mod	B+	parallel ext., cleav basal	biref. abnormal brown
5. Garnet	1	3mm	irregular to embayed	pink	high	(iso)		
6. Opaque (magnetite)	1	2mm	subhedral to euhedral	opaque				
7. Apatite	tr	0.5mm	equant, rounded	colorless	mod	U-		neg. elongation biref. 1st order grey
8. Zircon	tr	0.2mm	anhedral	colorless	high			biref. 3rd order
Others:								

TEXTURES: Relict porphyroblasts may or may not contain resorbed garnets. Where present, garnet reacting to form chlorite and quartz (and opaque?). Opaque may be concentrated and euhedral near relics.

Foliation defined by subparallel biotite. Folia wrap around relict porphyroblasts.

Laminae defined by varying biotite abundance.

Paragenesis: Garnet grade metamorphism with later garnet resorption during retrograde metamorphism.

Probable protolith altered felsic volcanic rock.

Remarks:

Rock Name: Biotite-chlorite-garnet gneiss

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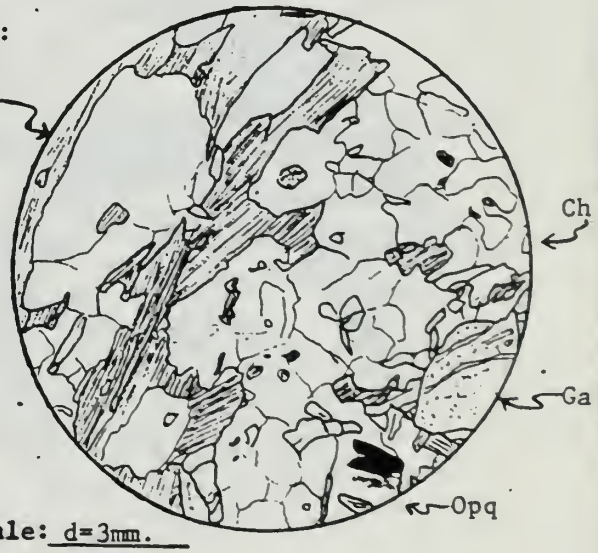

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-127' July, 1986

Hand Specimen Description Coarse, well foliated hornblende-biotite gneiss; grainsize less than 1 cm.; homogeneous appearance. Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	10	2mm	equant	colorless	low	U+	undulatory	biref. 1st order grey
2. Plagioclase (core An_{12} rim An_3)	30	3mm	tabular to equant	colorless	low	B- 2V=88°	ext. core=9° rim=6°	commonly zoned (irreg.) less commonly albite twinned
3. Hornblende	35	4mm	subhedral	lgt. blue-green to tan	mod	B- 2V=60°	max. 35° 2 cleav. 110°	biref. 2nd blue many inclusions: bio.plag.epi. opq.
4. Epidote	3	3mm	euhedral to subhedral	rim yellow core colorless	high	B- 2V=80°	ext.max 28° 2 cleav. (weak)	dispersion r>v biref. 3rd order opq. inclusions
5. Opaque (ilmenite)	2	1mm	tabular to irregular	opaque				
6. Biotite	20	3mm	subhedral	olive-grn /tan to colorless	mod	B- 2V=5°	ext. 2-3° basal cl.	biref. 3rd order pink
7. Calcite	tr	0.5 mm.	anhedral	colorless				
8.								
Others:								

TEXTURES:

Foliation defined by subparallel hbl, biotite, and epidote.

Hornblende may be poikilitic.

Epidote is strongly zoned with abrupt change to more ferric rim.

Paragenesis:

Lower amphibolite grade metamorphism of probable mafic volcanic rock.

Later metamorphism responsible for epidote rims (second period of growth).

Remarks:

Rock Name: Hornblende-biotite-epidote Amphibolite

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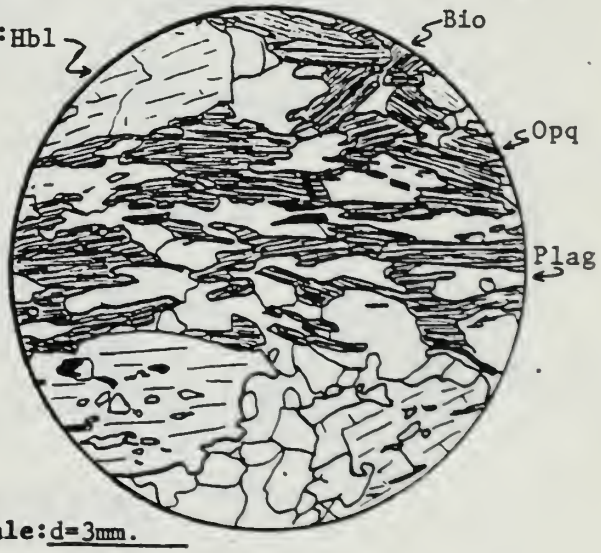

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-153 July, 1986

Hand Specimen Description Weakly foliated grey garnet-magnetite-amphibole gneiss; garnet porphyroblasts less than 7 mm. Strongly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	5	2mm	irregular to equant	colorless	low	U+	undulatory	
2. Plagioclase (An_8)	65	4mm	subhedral to tabular	colorless	low	B- 2V=84°	max. 13°	irregular zoning
3. Hornblende	5	4mm	sunhedral tabular	gr/blue-green to tan	mod	B- 2V=70°	max 27° 2 cleav 110°	biref. 2nd blue cumm exsolution (patchy distribution)
4. Cummingtonite	15	1-3 mm	subhedral equant to tabular	colorless	mod	B+ 2V=60°	2 cleav. 110°	commonly twinned biref. 2nd green hbl exsolution
5. Biotite	2	2mm	subhedral tabular	green-brown to tan	mod	B- 2V=3°	ext. 2-3° basal cl.	biref. 3rd pink
6. Garnet	5	6mm	irregular and embayed	pink				inclusions: qtz, opq.
7. Opaque (magnetite)	3	2mm	tabular to euhedral	opaque				
8. Chlorite	tr	1mm	subhedral mats	green to colorless	mod	B- 2V=5°	parallel ext., basal cleav.	biref. abnormal grey-brown
Others:								

TEXTURES: Hornblende may be partially rimmed by cummingtonite. Cumm. may be altering to chlorite. Chlorite grains may crosscut biotites.
Foliation defined by subparallel biotite, hornblende, and cummingtonite.
Strongly layered rock. (layers: cumm-bio-gar; hbl-rich; cumm-rich)

Paragenesis:
Amphibolite grade metamorphism.
Early formation of amphiboles allowed for exsolution during slow cooling. Later chlorite retrograde.
Probable protolith intermediate (Ca-poor) feldspathic volcanic rock.

Remarks:

Rock Name: Cummingtonite-hornblende-garnet-opaque-biotite plagioclase gneiss

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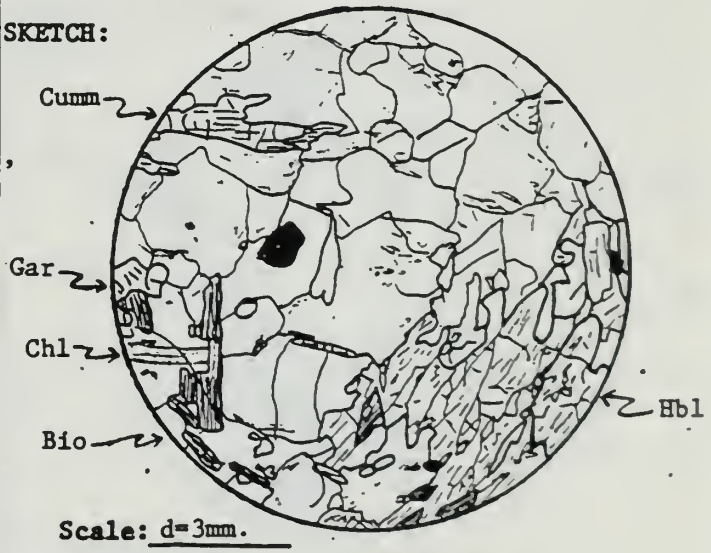

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-180' July, 1986

Hand Specimen Description Well foliated, bluish garnet-magnetite-biotite-muscovite gneiss; garnet-rich layers approximately 1 cm thick; weak crenulation in dominant mica foliation; Strongly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	20	2mm	equant to irregular	colorless	low	U+	undulatory	
2. Plagioclase	54	2mm	anhedral equant to tabular	colorless	low	B- 2V=88°	zoned ext.	strong zoning some twinning includes opq. or bio.
3. Biotite	10	3mm	subhedral tabular	olive-green to tan	mod	B- 2V=2°	ext. 2-3° basal cl.	biref. 3rd green may include garnet
4. Muscovite	10	3mm	subhedral tabular	colorless	mod	B-	ext. 2-3° basal cl.	biref. 3rd order may include garnet
5. Garnet	3	0.5mm	equant & rounded	pink	high	(iso)		granular texture zoned: included cores some color zoning.
6. Opaque (magnetite)	3	1mm	irregular to tabular	opaque				
7. Zircon	tr	0.3 mm	rounded		high			
8. Apatite	tr		subhedral	colorless				
Others:								

TEXTURES: Coticule-like granular garnets. Foliation defined by subparallel musc., biotite, & garnet-rich lenses.

Crosscutting biotite fabric; stubby-shaped biotite grains.

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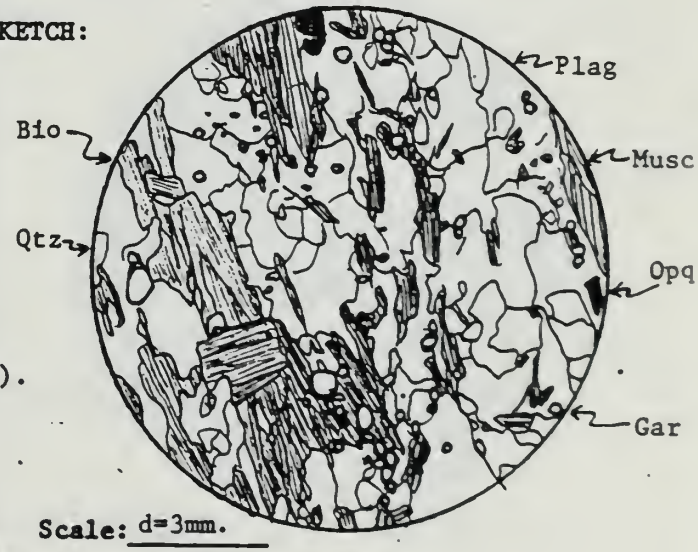

Scale: d=3mm.

Paragenesis:

Garnet grade metamorphism of probable aluminous felsic rock (possibly high Mn).
Later phase of metamorphism produced secondary biotite foliation.
Probable protolith volcanogenic sediment.

Remarks:

Rock Name: Biotite-muscovite-garnet-magnetite gneiss

Sample Number Goshen-198' July, 1986

Hand Specimen Description Well foliated, fine-grained, dark green hornblende-chlorite ultramafic rock; homogeneous appearance. Soapy feel to touch. Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	5	2mm	equant to irregular	colorless	low	U+	undulatory	
2. Plagioclase (An_{17})	10	3mm	irregular	colorless	low	B 2V=90°	strongly zoned	poikiloblastic some sericite
3. Talc	10	1mm	subhedral	colorless	mod		ext. 2-3° basal cl.	biref. 3rd order
4. Biotite	tr	1-1.5 mm	subhedral isolated grains	brown to colorless	mod		ext. 2-3° basal cl.	biref. 3rd green
5. Chlorite (Mg-rich)	40	1-3 mm	subhedral books	lgt green to colorless	mod	B- 2V=5°	ext.paral basal cl.	biref. abnormal tan to brown
6. Hornblende	35	4mm	subhedral equant to tabular	lgt green to blue-grn	mod	B- 2V=88°	2 cl. 110°	may include chlorite cumm. exsolution zoned:greener rims
7. Rutile	tr	0.5 mm	anhedral equant to oblong	dark brown				
8.								
Others:								

TEXTURES: Chlorite and Hornblende may be intergrown.

Talc may crosscut dominant foliation.

Foliation defined by subparallel chlorite and hornblende grains.

Paragenesis:

Amphibolite grade metamorphism of ultramafic rock; later retrograde and hydration produced some talc.

Remarks:

Rock Name: Hornblende-chlorite ultramafic rock.

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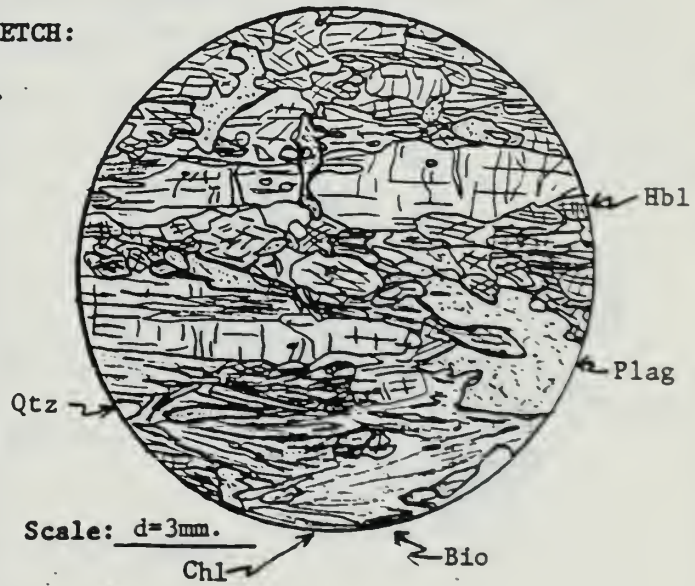

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-248' July, 1986

Hand Specimen Description Muscovite-garnet-magnetite gniess; Irregular laminae of quartz-rich layers and 1 cm. thick coticule layers; magnetite grains up to 3 mm. diameter; strong mica foliation. Strongly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1 Quartz	25	4mm	anhedral irregular	colorless	low	U+	undulatory	
2 Plagioclase	20	2-3 mm	anhedral irregular	colorless	low	B- 2V=88°	irregular zoning	poikilitic--includes gar, bio, opq., musc, qtz.
3 Biotite	8	2mm	subhedral	gr to gr-brown to tan	mod	B-	ext 2-3° basal cl.	biref. 3rd green
4 Muscovite	30	3mm	subhedral bladed	colorless	mod	B-	ext 2-3° basal cl.	biref. 3rd green
5 Garnet	12	0.4 mm	anhedral rounded	pink	high			granular texture
6. Opaque (magnetite and ilmenite)	5	0.5 - 2mm	irregular	opaque				
7.								
8.								
Others:								

TEXTURES: One large plagioclase poikiloblast is greater than 1 cm.
Some large opaques 2.5 x 1.5 mm, most less than 0.5 mm (bimodal).
Coticule-like granular garnets.
Foliation defined by subparallel musc., biotite, & elongate plagioclase.

Paragenesis:
Garnet grade metamorphism of probable Al, Mn volcanogenic sediment. Large plagioclase grains may by recrystallized phenocryst.

Remarks:

Rock Name: Muscovite-garnet-biotite-magnetite-ilmenite gneiss.

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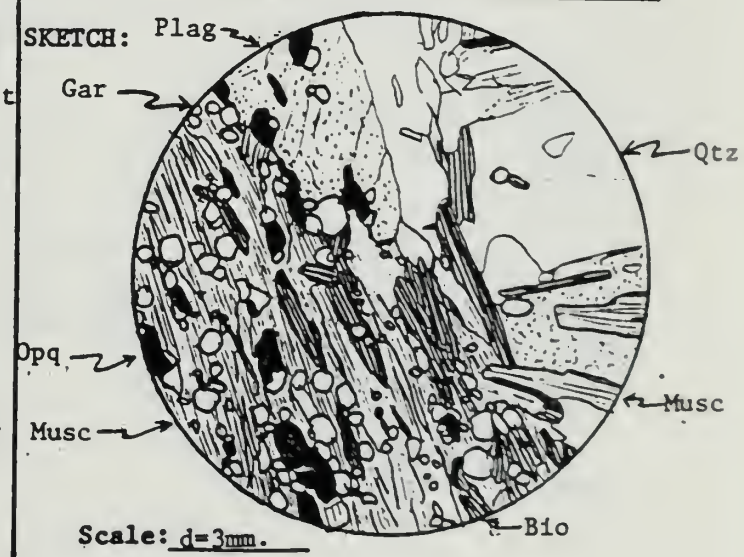

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-253 July, 1986

Hand Specimen Description Well foliated muscovite-biotite-garnet gneiss with local magnetite grains less than 2 mm diameter; compositional layering on scale of 1-2 mm; friable. Weakly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	30	4mm	anhedral elongate	colorless	low	U+	undulatory	
2. Plagioclase	20	2-3 mm	anhedral elongate	colorless	low	B- 2V=88°	zoned	poikilitic some twinning
3. Biotite	5	1-2 mm	subhedral bladed	green to tan or colorless	mod	B- 2V=2°	ext 2-3° basal cl.	biref. 3rd green
4. Muscovite	40	4mm	subhedral bladed	colorless	mod	B-	ext 2-3° basal cl.	biref. 3rd green
5. Garnet	3	0.5 mm	equant rounded	pink				granular texture
6. Opaque (magnetite and ilmenite)	2	0.5-2mm	anhedral elongate to equant	opaque				may include garnet
7. Chlorite	tr		anhedral	lgt green	mod	B- 2V=2°		
8. Zircon	tr		rounded					included in biotite
Others:								

TEXTURES: Coticule-like granular garnets
Gneissic layering on mm. scale.

Foliation defined by muscovite, biotite and oblong quartz and plagioclase.

Paragenesis:

Garnet grade metamorphism of aluminous (Mn-enriched) volcanogenic sediment.

Remarks:

Rock Name: Muscovite-biotite-garnet-magnetite-ilmenite gneiss

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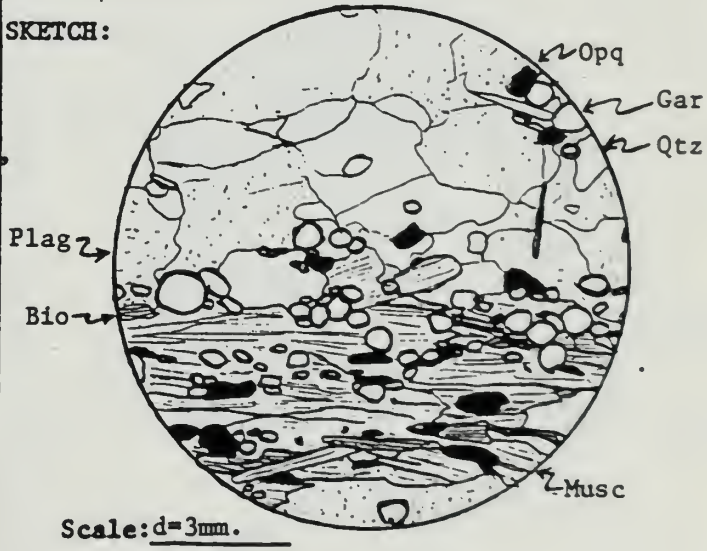

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-320' July, 1986

Hand Specimen Description Laminated, grey to green epidote-augite gneiss and Hornblende amphibolite; laminae on scale of 1-3 mm.; well developed foliation. Hornblende lineation. Interlayers of biotite gneiss. Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	10	1-2 mm	anhedral	colorless	low	U+	Undulatory	
2. Plagioclase	40	1-2 mm	anhedral	colorless	low	B- 2v=84°	irregular zoning	some albite twinning inclusions: epi, qtz
3. Hornblende	18	3mm	subhedral to irreg. tabular	gr/blue-green to tan	mod	B- 2V=60°	max. 28° 2 cl. 110°	inclusions: epi, qtz, bio actinolitic rims.
4. Epidote	22	1mm	granular	colorless to yellow	high	B- 2V=70°	some zoned	dispersion r> v (rare yellow cores)
5. Biotite	(tr)	2mm	subhedral tabular	brown to tan	mod	B- 2V=2°	ext 2-3° basal cl.	as inclusions in hbl only
6. Ca Pyroxene (augite)	10	1mm.	anhedral oblong	light green	high	B+ 2V=55°		biref. 2nd yellow
7. Opaque (ilmenite?)	tr	0.5 mm.						
8. Sphene	tr							
Others:								

TEXTURES: Compositional layering on mm. scale. Foliation defined by subparallel epidote and hornblende grains.

Paragenesis:
Lower amphibolite grade metamorphism of Ca-enriched mafic volcanic.

Remarks:

Rock Name: Epidote-hornblende-augite amphibolite and gneiss

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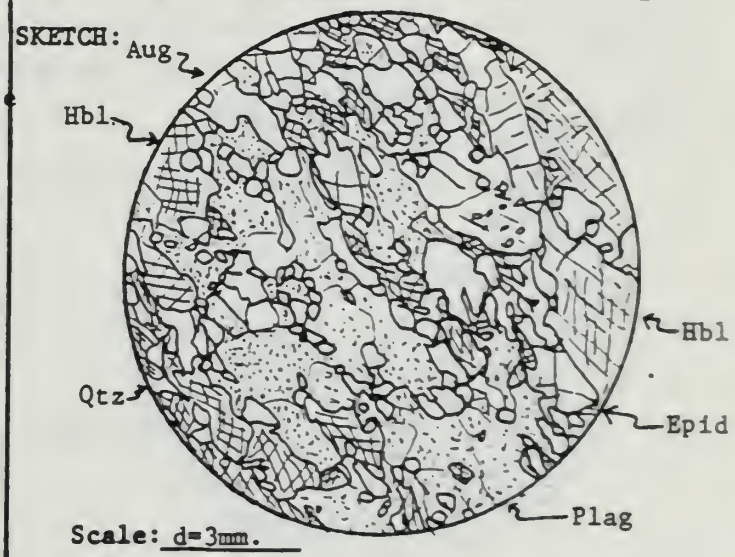

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-339 (amphibolite mode) July, 1986
Hand Specimen Description Green epidote-hornblende laminated amphibolite and gneiss with blue magnetite-garnet bed; hornblende lineation.
Three modes observed in thin section: amphibolite, gneiss, and quartzite.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	10	1-2 mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	30	1-2 mm	anhedral	colorless	low	B- 2V=88°	zoning common	carlsbad & albite twins some perthitic
3. Hornblende	40	2-3 mm	subhedral to anhedral elongate	green to tan	mod	B- 2V=40°	max 18° 2 cl. 110°	dispersion r > v
4. Epidote	15	1mm	anhedral equant to elongate	colorless (to yllw)	high	B- 2V=80°	2 cl 90°	biref. 2nd blue-green optically zoned
5. Sphene	tr		euhedral diamonds	brown	high			biref 3rd-4th included in epidote
6. Actinolite	5	2mm	subhedral tabular	light green	mod	B-	max. 15° 2 cl. 110°	commonly as rims on hornblende.
7.								
8.								
Others:								

TEXTURES: Hornblende may have actinolitic rims.
Hastingsite occurs at contact with magnetite-garnet quartzite.

Interlayered epid-plag-aug with hnbl-epid-plag-qtz at contact of mag-gar quartzite.

Paragenesis:
Amphibolite grade metamorphism of well-layered mafic and felsic volcanogenic rocks with rare Mn-rich quartz sediment. Epidote rich layers slightly enriched in calcium.

Remarks:

Rock Name: Interlayered hornblende-epidote amphibolite with epidote-augite gneiss and rare magnetite-garnet quartzite

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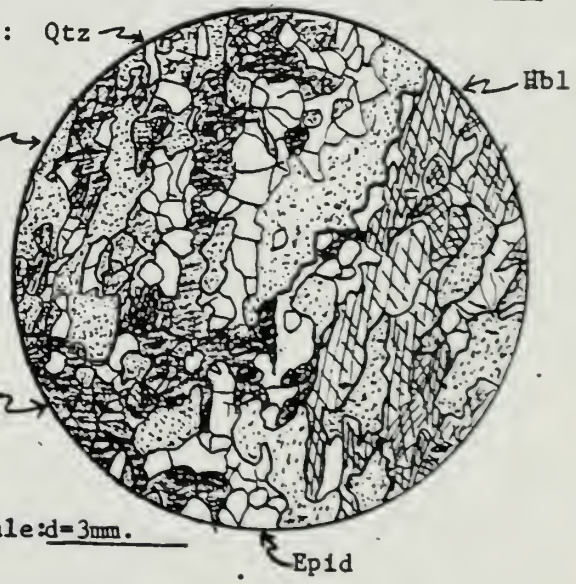

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-339 (epidote-augite gneiss mode) July, 1986
Hand Specimen Description Green epidote-hornblende laminated gneiss with blue magnetite-garnet bed; hornblende lineation.
Three modes observed in thin section.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	3	1-2 mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	23	1-2 mm	anhedral	colorless	low	B- 2V=88°	zoning common	carlsbad & albite twins some perthitic
3. Epidote	40	1mm	anhedral equant to elongate	colorless to yellow	high	B- 2V=80°	2 cl. 90°	biref. 2nd blue-gr. some optically zoned
4. Ca-pyroxene (augite)	27	1mm	equant to elongate	light green	high	B+ 2V=55°		biref. 2nd green
5. Hastingsite	tr	2mm	anhedral tabular	dark blue-green to olive	mod.	B- 2V=25°	2 cl. 110°	only at quartzite contact
6. Sphene	tr		euhedral diamonds	brown	high			biref. 3rd-4th included in epidote
7. Actinolite	5	2mm	subhedral tabular	light green	mod	B-	max 15° 2 cl. 110°	
8 Hornblende	2	3mm	subhedral to anhedral elongate	green to tan	mod	B- 2V=40	max 18° 2 cl. 110°	dispersion r v
Others:								

TEXTURES:

Paragenesis:

Remarks:

Rock Name: Epidote-augite gneiss

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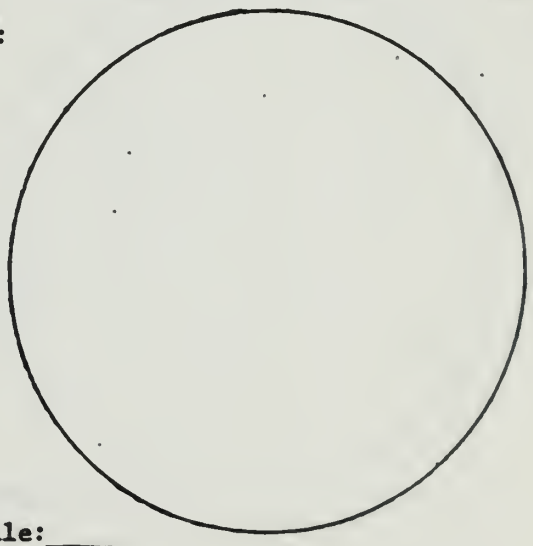

Scale:_____

Sample Number Goshen-339 (magnetite-garnet quartzite mode) July, 1986
Hand Specimen Description Green epidote-hornblende laminated gneiss with blue magnetite-garnet bed; hornblende lineation.
Three layers in thin section: amphibolite, gneiss, and coticule-like layer.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	87	2mm	anhedral	colorless	low	U+	undulatory	
2. Garnet	5	1mm	irregular to anhedral	pink to orange	high	(iso)		
3. Opaque (magnetite)	8	1mm	irregular to anhedral	opaque				
4.								
5.								
6.								
7.								
8.								
Others:								

TEXTURES:
Unidentified alteration at garnet rims.
Some augite, actinolite along contact with more mafic layers of gneiss and amphibolite.
Unusual garnet shape--highly irregular

Paragenesis:
Garnet grade metamorphism of probable Mn-enriched quartz rich sediment.

Remarks: Garnet texture does not appear similar to coticule-like rock.
Rock Name: Magnetite-garnet quartzite

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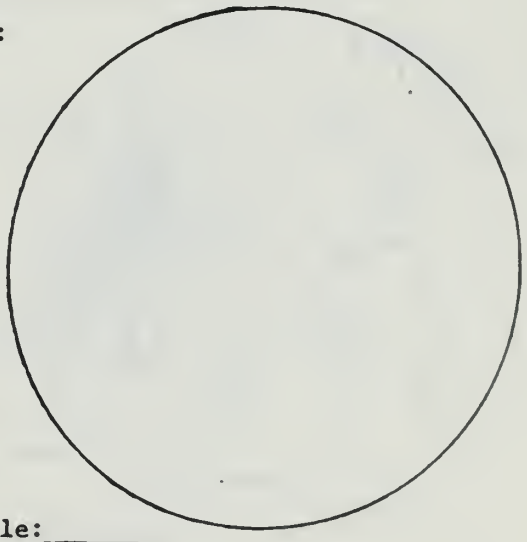

Scale:_____

PETROGRAPHIC REPORT

Sample Number Goshen-370' July, 1986

Hand Specimen Description Very coarse muscovite-kyanite-ilmenite schist; mica foliation exhibits small crenulation folds; books of musc. up to 1-2 cm thick, kyanite less than 5 mm. diameter. Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	40	3mm	anhedral equant to elongate	colorless	low	U+	undulatory	
2. Plagioclase	20	3mm	anhedral elongate	colorless	low	B+ 2V=87°	max 12°	albite twinning may include qtz, kyan, & musc.
3. Muscovite	25	3mm	subhedral bladed	colorless	mod	B- 2V=25°	ext 2-3° basal cl.	some sericite
4. Kyanite	5	1-4 mm	subhedral equant to bladed	colorless	high	B- 2V=80°	ext 0-15° 2 cl., & parting	may be simple twinned fine musc. rims
5. Opaque (ilmenite)	2	1mm	subhedral to anhedral tabular	opaque				
6. Biotite	8	3mm	subhedral bladed	pleochroic pale tan to colorless	mod	B- 2V=2°	ext. 2-3° basal cl.	biref. 3rd green
7.								
8.								
Others:								

TEXTURES: Kyanite may have very small rim of fine-grained white mica.
Irregular foliation defined by subparallel muscovite grains.
Opaque is probably ilmenite--platey and slightly magnetic when separated.

Paragenesis:
Kyanite-biotite grade metamorphism of probable Mg-enriched aluminous sediment.

Remarks: Biotite probably has extreme Mg composition based on color.

Rock Name: Muscovite-kyanite-ilmenite schist

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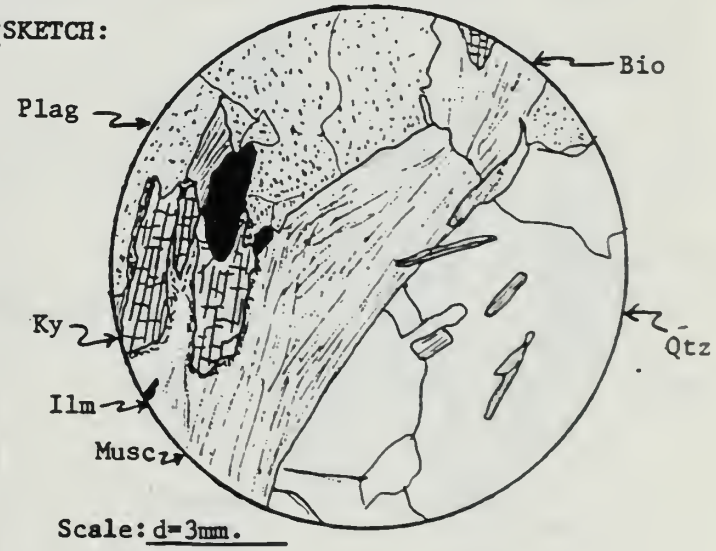

Scale: d=3mm.

Sample Number Goshen-385' July, 1986

Hand Specimen Description Coarse hornblende-biotite-cummingtonite-chlorite gneiss with garnet and magnetite; layers of quartz-rich and mica-rich composition; oblong pods of polycrystalline quartz 2 cm in length. Slightly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	25	2-3 mm	anhedral equant	colorless	low	U+	undulatory	
2. Plagioclase	39	2-3 mm	anhedral equant	colorless	low	B- 2V=86°	zoned	some albite twins
3. Biotite	8	1-3 mm	subhedral blades	green to tan or colorless	mod	B- 2V=2°	ext 2-3° basal cl.	biref. 3rd green
4. Hornblende	15	3mm	subhedral to irreg. blades	grn/blue-green to tan	mod	B- 2V=50°	max. 20° 2 cl. 110°	biref. 2nd purple
5. Cummingtonite	4	1-2 mm	subhedral blades	colorless	mod	B+ 2V=80°	max 21° 2 cl. 110°	biref. 2nd blue-green
6. Garnet	3	2-3 mm	irregular and embayed	pink	high			may include bio, qtz, & opaque
7. Chlorite	4	3mm	subhedral blades	lgt green to tan or colorless	mod		ext. parr. basal cl.	biref. abnormal brown (some grey & abnormal blues)
8. Opaque (magnetite)	2	½mm	anhedral irregular	opaque				
Others: Zircon	tr							included in bio & hbl
Apatite	tr		subhedral	colorless	mod	U-		biref. 1st grey

TEXTURES: No rimming or reaction textures observed on embayed garnets.
Fine-grained chlorite and sericite alteration found only along fractures.
Foliation moderately developed, somewhat irregular; defined by subparallel biotite, hornblende, & cummingtonite
Calcite may occur along fractures.

Paragenesis:
Amphibolite grade metamorphism of intermediate (Ca-poor) volcanic rock.
Later alteration along fractures with hydration.

Remarks:

Rock Name: Hornblende-biotite-chlorite-cummingtonite-garnet gneiss.

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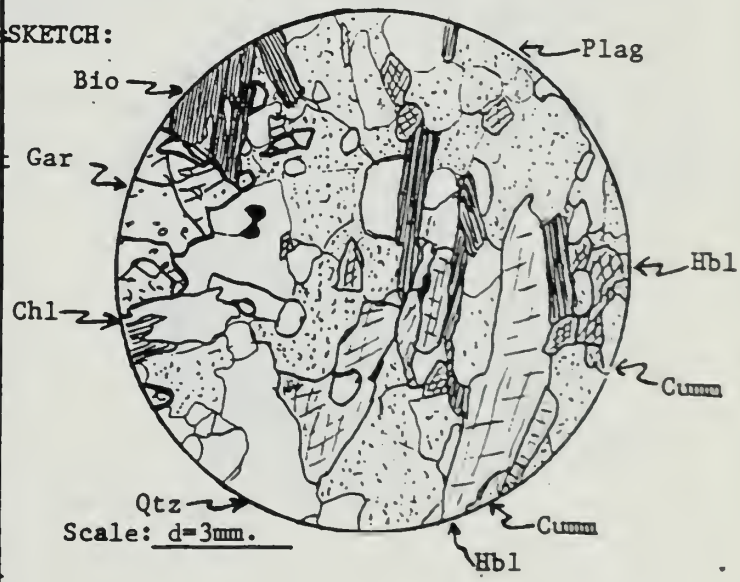

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-463 July, 1986

Hand Specimen Description Hornblende-biotite amphibolite and gneiss; layered on scale of 1-2 cm.; well foliated; relict porphyroblasts (?) and sulfide visible. Weakly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	15	1mm	anhedral equant	colorless	low	U+	undulatory	
2. Plagioclase	40	1-2 mm	anhedral	colorless	low	B- 2V=85°	zoned	perthitic albite twins rare
3. Hornblende	37	1-4 mm	anhedral to subhedr. elongate	grn/blue-green to tan	mod	B-	ext. 20° 2 cl. 110°	biref. 2nd blue
4. Biotite	5	2mm	subhedral blades	light brown to tan	mod	B- 2V=4°	ext 2-3° basal cl.	biref. 3rd green
5. Opaque (magnetite) (ilmenite)	3	0.75 mm	irregular	opaque				
6. Zircon	tr							
7. (Sulfide)	tr							(seen in hand specimen)
8.								
Others:								

TEXTURES: Compositional banding defined by variable abundance of hornblende. Foliation defined by subparallel hornblende and biotite. Biotite may crosscut dominant foliation.

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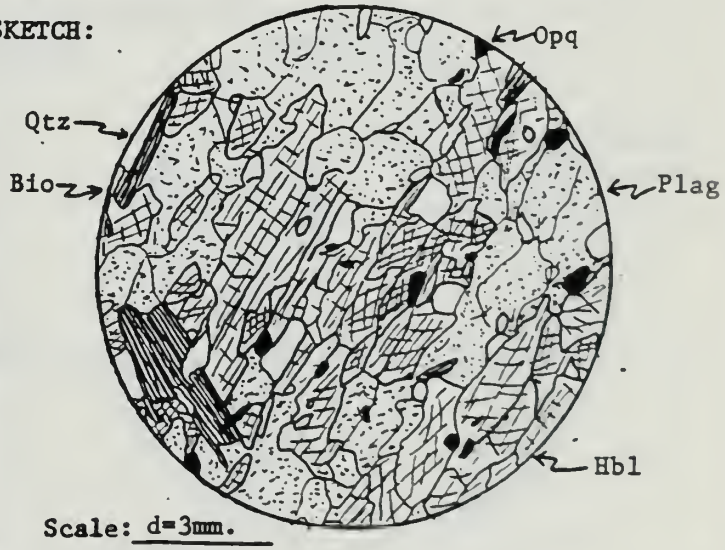

Scale: d=3mm.

Paragenesis:

Amphibolite grade metamorphism with later retrograde metamorphism which produced weak secondary biotite foliation.

Probable protolith mafic volcanic rock.

Remarks:

Rock Name: Hornblende-biotite amphibolite

PETROGRAPHIC REPORT

Sample Number Goshen-537 July, 1986

Hand Specimen Description Hornblende amphibolite with minor biotite and garnet; relict porphyroblasts and sulfide visible; well developed foliation defined by subparallel hornblende grains. Weakly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	10	1-2 mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase (An_{16})	40	1-2 mm	anhedral	colorless	low	B- 2V=88°	max 6° zoned	(6 measured) irreg. twinning rarely poikilitic
3. Hornblende	46	3mm	anhedral to subhedral irregular	grn/blue-green to tan	mod	B- 2V=50°	max 25° 2 cl. 110°	biref. 2nd blue
4. Biotite	2	2mm	subhedral to anhedral	brown to tan	mod	B- 2V=3°	ext 2-3° basal cleav.	biref. 3rd green
5. Opaque (magnetite)	2	0.5-1mm	anhedral irregular	opaque				
6. Chlorite (Fe-rich)	tr	1mm	subhedral	green	mod		ext. parr	biref. abnormal blue
7. Apatite	tr							
8. (Sulfide)	tr							(seen in hand specimen)
Others:								

TEXTURES: Intergrowths of biotite and chlorite perpendicular to dominant foliation (subparallel hornblende). Relict porphyroblast (former grain) now an intergrowth of hbl, qtz, plag, and opq. with smaller grainsize than matrix and irregular grain shapes. Fine-grained chl & sericite alteration along fractures.

Paragenesis:
Amphibolite grade metamorphism of probable mafic volcanic rock. Later retrograde produced weak biotite-chlorite foliation (crosscutting hornblende foliation).

Remarks:

Rock Name: Hornblende amphibolite

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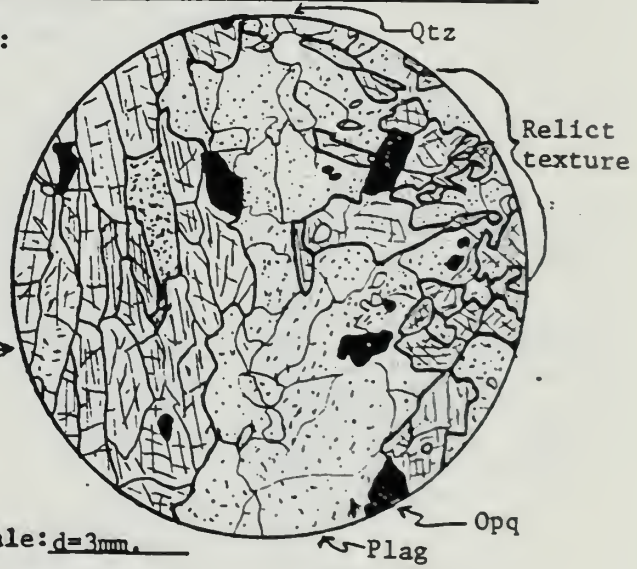

Scale: d=3mm.

Sample Number Goshen-573 July, 1986

Hand Specimen Description Garnet-hornblende amphibolite ; strongly foliated with garnet porphyroblasts 1-2 cm diameter; sulfide and concentrations of quartz associated with garnet porphyroblasts. Slightly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	10	1-2 mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase (An_{12})	19	1-3 mm	anhedral	colorless	low	B- 2V=88°	max 10° zoned	(6 measured)
3. Hornblende	65	3mm	subhedral to anhedral	grn/ blue-green to tan	mod	B- 2V=50	max 21° 2 cl. 110°	biref. 2nd blue (.02)
4. Garnet	2	2mm	irregular to embayed	pink	high	(iso)		
5. Biotite	1	1-2 mm	subhedral to anhedral	brown to tan	mod	B-	ext 2-3° basal cleav	biref. 3rd green
6. Chlorite	1		subhedral	green to tan	mod	B+	ext. parr basal cl.	biref. abnormal brown to blue
7. Opaque (magnetite)	1	1mm	very irregular	opaque				
8. Cummingtonite	1	1mm	subhedral to anhedral	colorless	mod			biref. 2nd bright blue (.023)
Others: (Sulfide)	tr							(seen in hand sample)
Zircon	tr							
Calcite	tr							only as alteration

TEXTURES: Embayed garnet reacting to form biotite, Fe-chlorite, & plagioclase.
Alteration zones along fractures: fine-grained chlorite & sericite. Zones up to 1 mm thick. Chl and Bio commonly intergrown here.
Thick bands of Hbl and Qtz-rich layers containing garnet are crosscut by these fractures.

Paragenesis:
Amphibolite grade metamorphism of probable mafic volcanic rock.
Garnet consumption during later retrograde metamorphism.
Hydration and alteration locally along fractures.

Remarks:

Rock Name: Hornblende-garnet amphibolite

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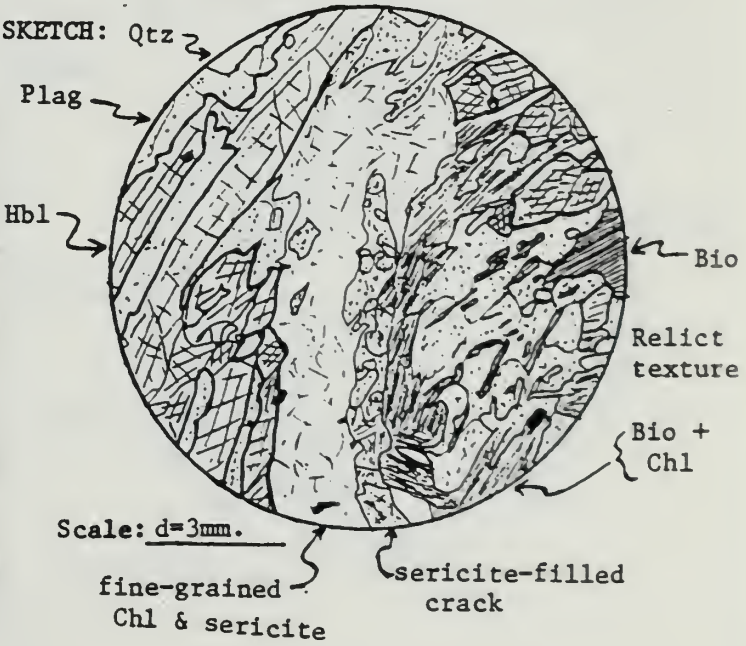

PETROGRAPHIC REPORT

Sample Number Goshen-635 (amphibolite mode) July, 1986
Hand Specimen Description Laminated to massive hornblende-biotite amphibolite with minor grey biotite gneiss. Sulfide present in amphibolite.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	15	1-4 mm	anhedral equant to elongate	colorless	low	U+	undulatory	
2. Plagioclase	25	1-2 mm	anhedral	colorless	low	B- 2V=88°		
3. Hornblende	40	2-3 mm	subhedral bladed to irregular	grn/blue-green to tan	mod	B- 2V=40°	max 20° 2 cl. 110°	biref. 2nd blue (.021)
4. Biotite	20	2-3 mm	subhedral bladed	dark brown to tan	mod	B-	ext 2-3° basal cl.	biref. 3rd green
5. (Sulfide)	tr							(seen in hand specimen)
6.								
7.								
8.								
Others:								

TEXTURES: Biotite and hornblende grain size is smaller in gneissic layers.

Foliation is defined by subparallel biotite, hornblende, and oblong plagioclase.

Epidote, hastingsite, and darker brown biotite are found in gneiss.

Paragenesis:
Amphibolite grade metamorphism of a well layered aluminous mafic volcanic rock.

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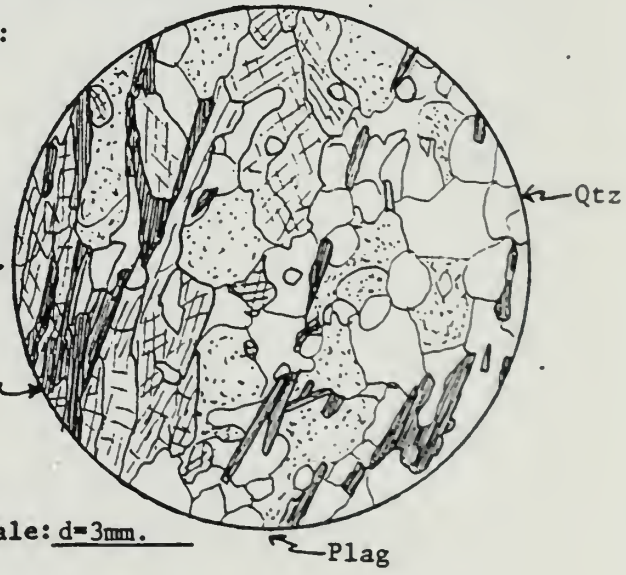

Scale: d=3mm.

Remarks:
Rock Name: Hornblende-biotite amphibolite with minor biotite-hastingsite gneiss

PETROGRAPHIC REPORT

Sample Number Goshen-635 (biotite-plagioclase-hastingsite gneiss) July, 1986
Hand Specimen Description Laminated to massive hornblende-biotite amphibolite with minor grey biotite gneiss. Sulfide present in amphibolite.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	48	1-4 mm	anhedral equant to elongate	colorless	low	U+	undulatory	
2. Plagioclase	41	1-2 mm	anhedral	colorless	low	B- 2V=88°		
3. Biotite	4	2-3 mm	subhedral blades	dark brown to tan	mod	B-	ext 2-3° basal cl.	biref. 3rd green
4. Hastingsite	5	3mm	anhedral tabular	dark green to tan	mod	B- 2V=25°	2 cl. 110°	biref. 1st red
5 Hornblende	tr	2-3 mm	subhedral bladed to irregular	grn/blue-green to tan	mod	B- 2V=40°	2 cl. 110°	biref. 2nd blue
6 Epidote	1	0.5 mm	subhedral to euhedral	colorless	high			
7. Opaque (magnetite)	tr	0.5 mm	irregular	opaque				
8.								
Others:								

TEXTURES:

Paragenesis:

Remarks:
Rock Name: Biotite-hastingsite gneiss

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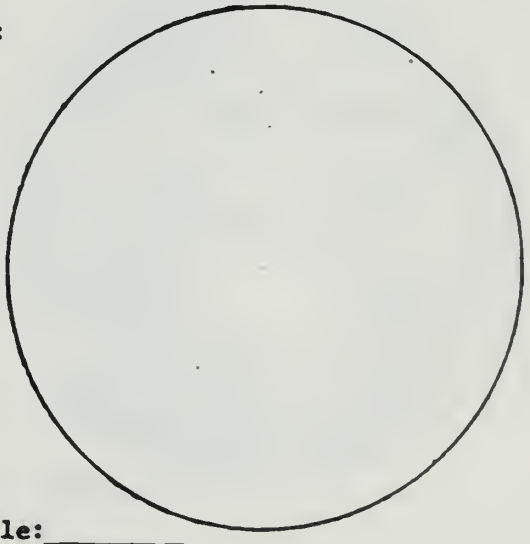

Scale:_____

Sample Number Goshen-666 July, 1986

Hand Specimen Description Well layered to massive biotite amphibolite , not magnetic; contains sulfide. Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	15	2-3 mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase (An_9)	24	3mm	anhedral	colorless	low	B- 2V=88°	max. 13° zoned	albite twinning
3. Hornblende	50	2-3 mm	subhedral elongate	grn/blue-green to tan	mod	B- 2V=55°	max 23° 2 cl. 110°	some twinned biref. 2nd blue-green (.024)
4. Biotite	8	3mm	subhedral bladed	orange-brown to tan	mod	B-	ext. 2-3° basal cl.	biref. 3rd green
5. Prehnite	tr	2mm	subhedral bladed	colorless	mod			biref. 3rd green
6. Opaque (ilmenite?)	tr	0.25 mm	anhedral irregular	opaque				
7. Sphene	3	0.20 mm	euhadral to subhedr.	brown	high			biref. 3-4 order
8. Zircon (Sulfide)	tr tr							(seen in hand sample)
Others: Apatite	tr	0.5 mm.	equant	colorless	high	U-		

TEXTURES: Sphene may be included in bio, hbl, or plag.
Foliation defined by hbl, bio, & plag. subparallel orientation.

Paragenesis:

Amphibolite grade metamorphism of probable mafic volcanic rock.
Prehnite formed during prob. retrograde metamorphism.

Remarks:

Rock Name: Hornblende-biotite- sphene amphibolite

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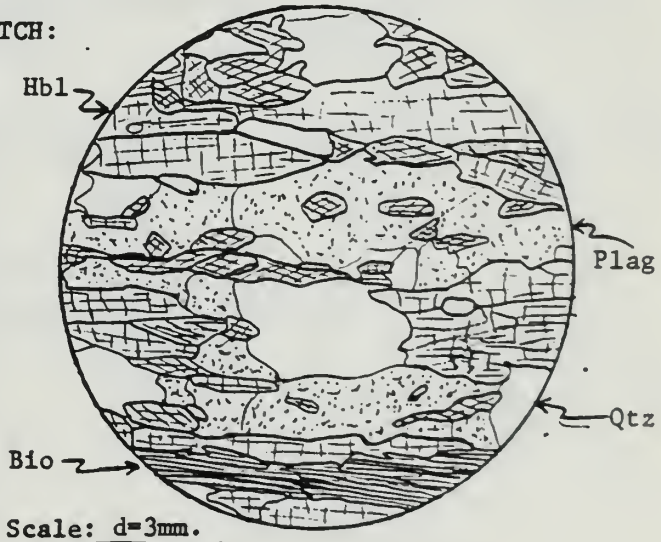

Scale: d=3mm.

Sample Number Goshen-686 July, 1986

Hand Specimen Description Coarse, strongly foliated hastingsite-biotite gneiss with darker grey inclusions. Weakly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	45	1-2 mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase (An_8)	39	1-2 mm	anhedral	colorless	low	B-	max. 14° zoned	twinning common irreg. twinning commonly sericitized
3. Hastingsite	5	2-3 mm	anhedral to euhedral	dark blue-green to green, tan	mod	B- 2V=20°	max 35° 2 cl. 110°	dispersion r>v biref. first red
4. Garnet	1	1mm	anhedral	pink	high	(iso)		may include qtz
5. Biotite	4	1-2 mm	subhedral to anhedral	opaque brown to tan	mod	B- 2V=2°	ext. 2-3° basal cl.	biref. 3rd green
6. Chlorite (intermediate)	2		subhedral to anhedral	green to tan	mod	B- 2V=8°	parr. ext basal cl.	biref. abnormal violet
7. Opaque (magnetite)	1	1mm	anhedral to euhedral	opaque				
8. Epidote	3	1mm	subhedral to euhedral	colorless	high	B- 2V=83°	max 20° 2 cleav.	biref. 2nd green
Others: Zircon	tr				high			biref. 3-4 order
Apatite	tr	0.5 mm		colorless	mod	U-		biref. 1st grey

TEXTURES: Chlorite and biotite or chlorite, biotite, and epidote may be intergrown. Foliation defined by subparallel biotite and hastingsite grains.

Hastingsite may include epidote, opaque, or biotite.

Paragenesis:

Amphibolite grade metamorphism of Fe-enriched felsic volcanic rock. Biotite and chlorite intergrowths probably later retrograde effect.

Remarks:

Rock Name: Biotite-hastingsite-epidote-garnet plagioclase gneiss

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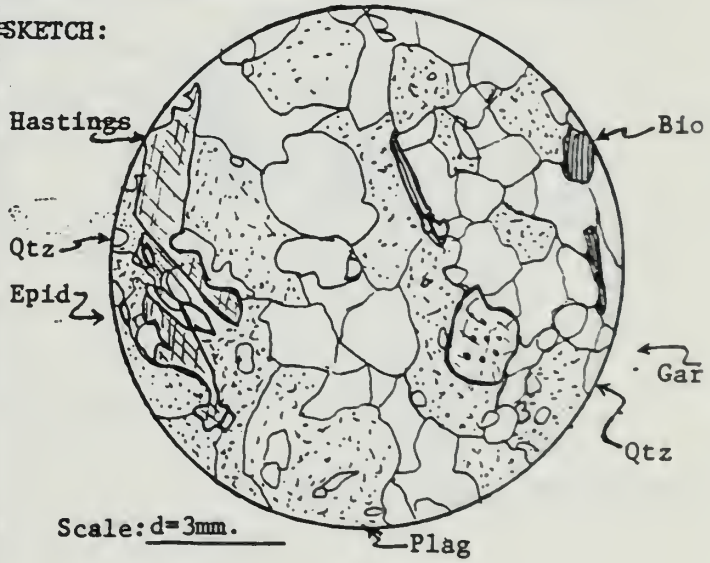

Scale: d=3mm.

Sample Number Goshen-718 July, 1986

Hand Specimen Description Layered grey- to dark-grey biotite-hastingsite gneiss; moderately developed foliation. Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	42	3mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	34	2-3 mm	anhedral	colorless	low	B- 2V=88°	zoned	irreg. twinning
3. Hastingsite	12	3mm	subhedral to euhedral	grn/blue-green to tan	mod	B- 2V=30°	max. 30° 2 cl. 110°	biref. 1st orange (.016) dispersion r > v
4. Biotite	10	2mm	subhedral	brown to tan	mod	B- 2V=4°	ext 2-3° basal cl.	biref. (.025) 3rd green includes epid. & opq.
5. Epidote	1	0.5 mm	euhedral to subhedral	colorless	high	B-	2 cleav.	biref. 2nd green
6. Opaque	1	0.5 mm	anhedral	opaque				
7. Garnet	tr	0.5 mm	anhedral irregular	pink	high	(iso)		
8. Chlorite (intermediate)	tr	1mm	subhedral	green to tan	mod		parr. ext basal cl.	biref. abnormal violet
Others: Zircon	tr				high			biref. 3-4 order
Apatite	tr			colorless	mod	U-		biref. 1st grey

TEXTURES: Biotite and hastingsite may be poikiloblastic, including quartz and plagioclase.
Biotite may be intergrown with epidote.
Almost no sericite observed.
Foliation defined by subparallel biotite and hastingsite.

Paragenesis:

Amphibolite grade metamorphism of probable Fe-enriched intermediate volc. rock.

Remarks:

Rock Name: Biotite-hastingsite-epidote gneiss

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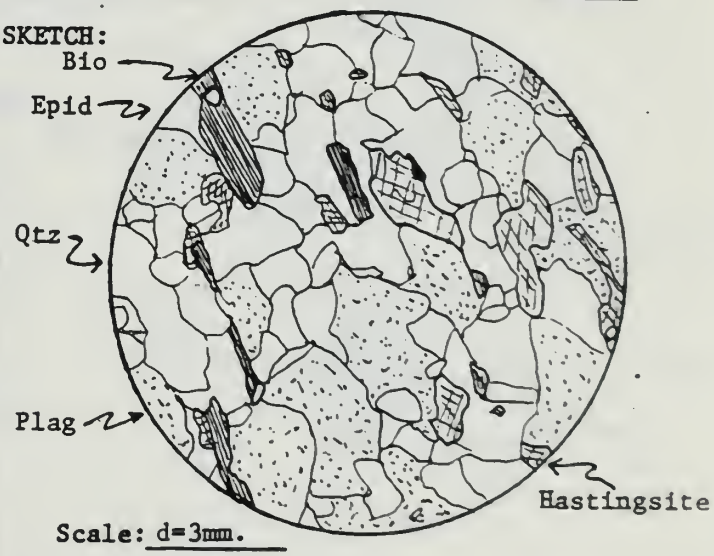


Scale: d=3mm.

Sample Number Goshen-824 July, 1986

Hand Specimen Description Garnet- and chlorite-bearing biotite-amphibole gneiss; garnet porphyroblasts less than 3 mm diameter. Slightly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	30	2mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	38	2mm	anhedral	colorless	low	B 2V=88°	zoned	
3. Hornblende	12	2mm	subhedral bladed	blue-green to tan	mod	B- 2V=65°	2 cl. 110°	Biref. 2nd purple (.019) includes qtz & opq.
4. Biotite	10	3mm	subhedral bladed	olive-grn to tan	mod	B- 2V=2°	ext 2-3° basal cl.	biref. 3rd green includes opaque.
5. Garnet	3	2mm	very irreg embayed	pink	high	(iso)		
6. Cummingtonite	3	2mm	subhedral bladed	colorless	mod	B+ 2V=77°	max 17° 2 cl. 110°	biref. 2nd blue (.024)
7. Chlorite (Mg-rich)	3	2mm	subhedral	green	mod	B+ 2V=10°	parr. ext basal cl.	biref. abnormal brown
8. Opaque	1	0.5 mm (1mm)	subhedral	opaque				
Others: Zircon	tr	0.3 mm			high			biref. 3-4 order
Apatite				colorless	mod	U-		biref. 1st grey

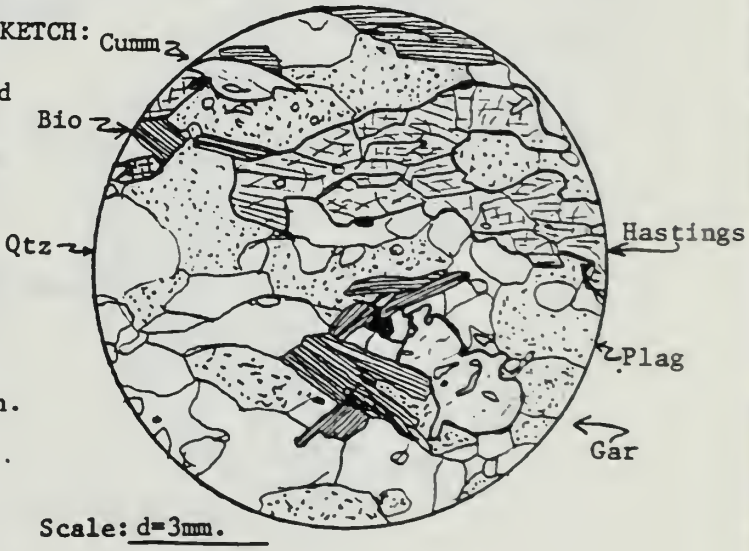
TEXTURES: Biotite may be intergrown with either opaque or chlorite.
Alteration along fractures of fine-grained chlorite and sericite.
Embayed garnets reacting to form chlorite and biotite.
Foliation defined by subparallel biotite and hornblende.
Chlorite occurs only in association with alteration or garnet reaction.

Paragenesis: Amphibolite grade metamorphism of probable Ca-poor intermediate volcanic; slow cooling to allow amphibole exsolution. Later garnet consumption during retrograde metamorphism; alteration along fractures due to hydration.

Remarks:

Rock Name: Hornblende-biotite-garnet-cummingtonite plagioclase gneiss

SKETCH:



Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-850 July, 1986

Hand Specimen Description Homogeneous intermediate to dark grey biotite-amphibolite gneiss. Moderately well foliated. Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	41	2mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase (core An_{12} (rim An_5	30	2mm	anhedral	colorless	low	B- 2V=88°	zoned core 8° rim 16°	(7 measured) strongly zoned incl.gar, opq, qtz, epi
3. Hastingsite	12	2mm	subhedral to euhedral	green/blue -green to tan	mod	B- 2V=25°	2 cl. 110°	biref. 2nd violet dispersion r> v. includes qtz & plag.
4. Biotite	15	2mm	subhedral bladed	dark brown to tan	mod	B- 2V=3°	ext. 2-3° basal cl.	biref. 3rd green includes epi., zircon
5. Epidote	tr	0.3 mm	subhedral	colorless	high	B $2V_{high}$		biref. 2nd green
6. Garnet	tr	0.5 mm	anhedral	pink	high	(iso)		
7. Chlorite (intermediate)	tr	1mm	subhedral	green	mod		parr. ext basal cleav.	biref. abnormal violet
8. Opaque	2	0.2 mm	anhedral	opaque				
Others: Zircon	tr							
Apatite	tr							

TEXTURES:

Hastingsite may be poikilitic.
Chlorite and biotite may be intergrown.
Homogeneous appearance, but changing proportions of hbl & biotite form compositional laminae.

Paragenesis:

Amphibolite grade metamorphism of probable Fe-enriched intermediate volcanic rock.
Chlorite and biotite intergrowths probably later retrograde effect.

Remarks:

Rock Name: Biotite-hastingsite plagioclase gneiss

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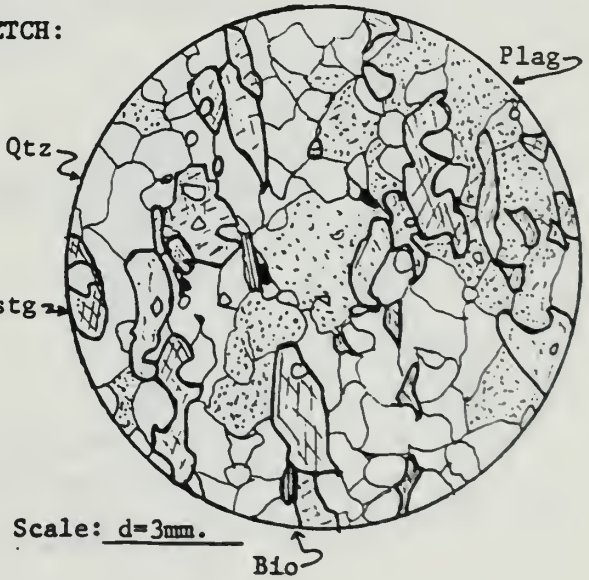


Scale: d=3mm.

Sample Number Goshen-888 July, 1986

Hand Specimen Description Homogeneous dark grey gneissic amphibolite; garnet and abundant magnetite. Magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	40	2mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	39	2mm	anhedral	colorless	low	B- 2V=88°	zoned	
3. Hornblende	11	2mm	subhedral to euhedral	green/blue-green to tan	mod	B- 2V= 40°	max 20° 2 cl. 110°	Biref. 2nd violet includes qtz & plag. dispersion r> v simple twins
4. Garnet	3	0.5 mm	anhedral globular	pink	high	(iso)		includes opq.
5. Chlorite	4	1mm	subhedral	green to tan	mod	B	parr.ext. basal cl.	biref. abnormal blue and violet
6. Epidote	1	0.5 mm	subhedral to euhedral	colorless	high		2 cleav.	biref. 2nd green (.028)
7. Biotite	tr	3mm	subhedral bladed habit	dark brown to tan	mod	B-	2-3° Ext. basal cl.	biref. 3rd green
8. Opaque (magnetite)	2	1mm	subhedral to euhedral	opaque				
Others: Zircon	tr							
Apatite	tr							

TEXTURES:

Hornblende may be poikilitic.
Foliation defined by subparallel needles of hornblende.
Alteration along fractures of chlorite, epidote, and sericite.

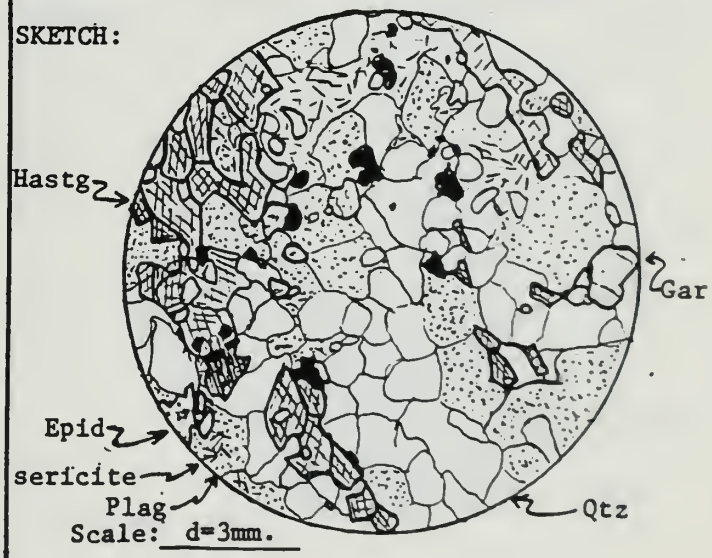
Paragenesis:

Amphibolite grade metamorphism of probable intermediate volcanic rock.

Remarks:

Rock Name: Hornblende-garnet plagioclase gneiss

SKETCH:



Scale: d=3mm.

Sample Number Goshen-957' July, 1986
Hand Specimen Description Strongly foliated homogeneous amphibolite sill.
Not magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	15	1mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	35	1mm	anhedral	colorless	low	B- 2V=88°	zoned	
3. Hornblende	47	2mm	subhedral	opaque-brown to tan/clrless	mod	B- 2V=50°	max 23° 2 cl. 110	biref. 2nd blue (.023)
4. Biotite	tr	0.75 mm	subhedral	orange-br to tan/ colorless	mod	B-	ext 2-3° basal cl.	biref. 3rd green
5. Sphene	3	0.20 mm	subhedral	brown	high			biref. 3-4 order
6. Opaque (ilmenite?)	tr	0.20 mm	anhedral	opaque				
7.								
8.								
Others:								

TEXTURES:

Foliation defined by subparallel hornblende orientation.

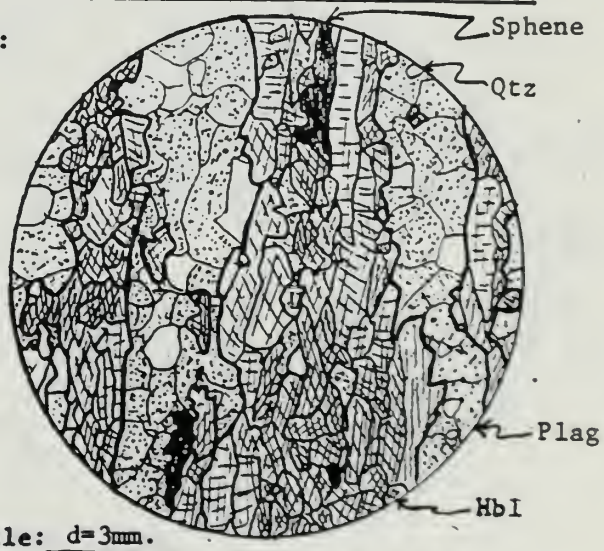
Paragenesis:

Amphibolite grade metamorphism of probable mafic intrusive rock.

Remarks:

Rock Name: Hornblende-sphene amphibolite

SKETCH:



Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-972' July, 1986

Hand Specimen Description Homogeneous grey biotite gneiss with pinhead garnets. Slightly magnetic.

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	40	3mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	50	1-2 mm	anhedral	colorless	low	B- 2V=88°	zoned (ext. 13°)	twinning rare includes qtz, bio, & apatite.
3. Biotite	10	3mm	subhedral bladed	opaque-brown to tan	mod	B- 2V-5°	ext 2-3° basal cl.	biref. 3rd green includes epi, qtz, & plag.
4. Garnet	tr	0.5 mm	anhedral globular	pink	high	(iso)		
5. Epidote	tr	0.20 mm	subhedral to anhedral	colorless	high		2 cleav.	biref. 2nd green
6. Opaque (magnetite)	tr	1mm	subhedral	opaque				
7. Hornblende?	tr	0.10 mm	anhedral to subhedral	green to olive-green	mod		cl.??	biref. 1st orange
8. Chlorite	tr	0.5 mm	subhedral	green				biref. abnorm.violet
Sphene	tr	0.20mm		brown				biref. 4th green
Others: Zircon	tr							
Apatite	tr							

TEXTURES:

Biotite may have trace of chlorite at rims.

Two prominent directions of biotite orientations define two crosscutting foliations.

Paragenesis:

Garnet grade metamorphism with later phase of metamorphism causing reorientation of biotite.

Probable protolith felsic volcanic rock

Remarks:

Rock Name: Biotite - plagioclase gneiss

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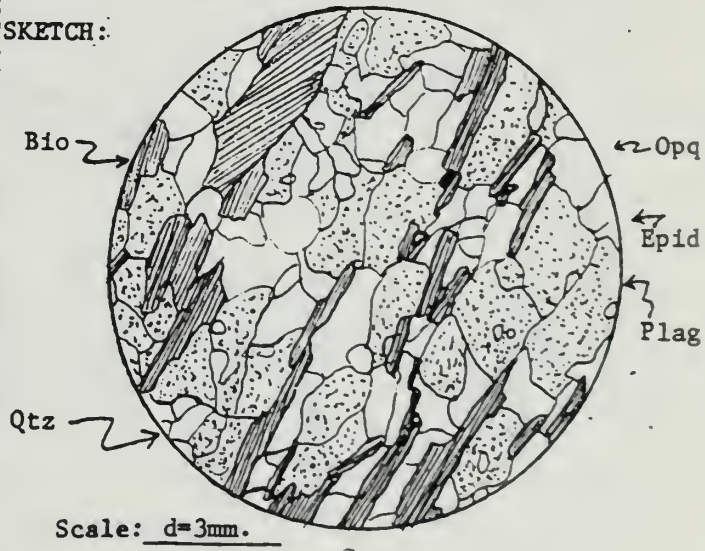

Scale: d=3mm.

PETROGRAPHIC REPORT

Sample Number Goshen-998 July, 1986

Hand Specimen Description Light grey to green homogeneous chlorite and/or biotite gneiss with local magnetite. Slightly magnetic..

MINERAL	Mod. %	Size	Shape	Color	Index	Optic prop.	Extinct., cleavage	Other
1. Quartz	50	2mm	anhedral	colorless	low	U+	undulatory	
2. Plagioclase	33	2mm	anhedral	colorless	low	B- 2V=89°		sericitized includes qtz.& sphene
3. Biotite	7	2mm	subhedral blades	olive-grn /brown to tan	mod	B-	ext 2-3° basal cl.	biref. 3rd green
4. Chlorite	8	2mm	subhedral may be fine-grned	green to tan	mod		parl. ext basal cl.	biref. abnormal blue, brown, and violet
5. Garnet	1	0.80 mm	anhedral	pink	high	(iso)		includes opq., and colorless euhedral (unidentified) xtals.
6. Muscovite	1	0.50 mm	subhedral	colorless	mod		ext 2-3° basal cl.	
7. Opaque (magnetite)	tr	1mm	subhedral to anhedral	opaque				
8. Sphene	tr							
Others: Zircon	tr							

TEXTURES:

Biotite commonly intergrown with chlorite and/or muscovite.
Muscovite found only as sericite or intergrown with bio & chl.
Garnet reacting in places to form chl + biotite.
Difference in hydration state across section?

Paragenesis:

Garnet grade metamorphism of aluminous felsic volcanogenic rock.

Garnet breakdown to form chlorite and biotite during later period of metamorphism. Alteration due to late hydration.

Remarks:

Rock Name: (altered) Biotite-garnet-magnetite plagioclase gneiss

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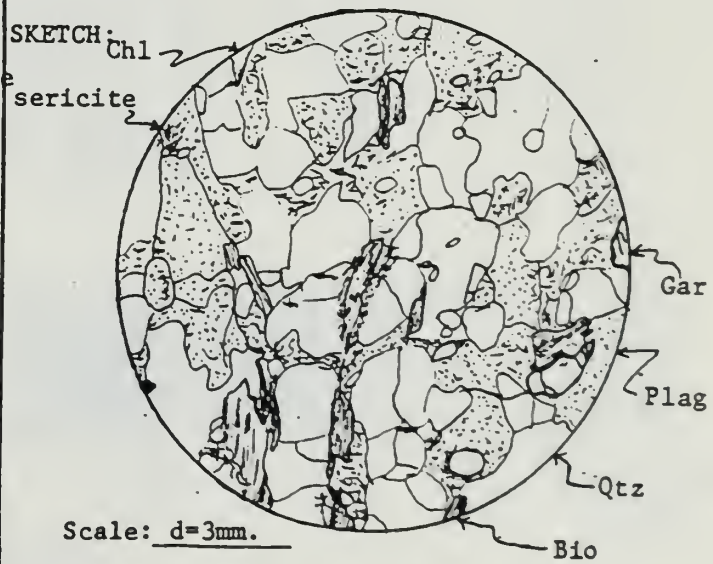

Scale: d=3mm.

GOSHEN DOME DIAMOND DRILL HOLE

TELESCOPIC CORE LOG

Prepared by Peter Robinson
Department of Geology and Geography
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Amherst, MA 01003
February 3-7, 1986
Revised September 23, 1986

0 - 19'	Unconsolidated overburden.
19 - 97.5'	Laminated garnet-chlorite-biotite-magnetite gneiss with muscovite- pink feldspar pegmatite.
97.5 - 135.3'	Coarse hornblende-biotite gneiss and biotite amphibolite with highly varied magnetism.
135.3 - 158.5'	Well layered biotite amphibolite.
158.5 - 169'	Gray garnet-magnetite-biotite-chlorite gneiss.
169 - 179'	Gray Gneiss interbedded with coarse hornblende-epidote amphibolite.
179 - 223'	Massive ultramafic hornblende-chlorite-biotite rock. 180-181': bluish garnet-biotite-magnetite gneiss with isoclinally folded garnet layers. At 221': 2" of garnet-feldspar rock. Hornblende rock becomes very coarse in lowest 2-3'.
223 - 225'	Laminated hornblende-plagioclase amphibolite.
225 - 261'	Muscovite-biotite-garnet feldspar gneiss with local magnetite. 248-249: muscovite-magnetite gneiss with coticule layers.
261 -283.4'	Garnet-biotite-muscovite gneiss, interbedded medium- to fine-grained.
283.4 - 344.1'	Laminated epidote amphibolite and biotite amphibolite. Blue magnetite-garnet bed at 339'.
344.1 - 363.2	Interlayered hornblende-epidote amphibolite and magnetite-biotite gneiss.
363.2 - 382'	Very coarse muscovite-biotite-ilmenite schist (not magnetic). Locally minor garnet and magnetite.
382 - 402'	Coarse biotite-chlorite gneiss with minor garnet and magnetite.
402 - 410'	Muscovite - Pink feldspar pegmatite.
410 - 477'	Hornblende-biotite-epidote amphibolite and gneiss. Volcaniclastic textures with coarse fragments.
477 - 482'	Pegmatite.
482 - 557'	Amphibolite with biotite and some garnet, minor

Reference and support materials for this project have been forwarded to the State Archives and the U.S. Department of Energy.

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